Kentucky Equine Research®
World Leaders In Equine Nutrition

Advances in Equine Nutrition

Volume II

Edited by

J.D. Pagan

FEEDING AND MANAGEMENT PRACTICES IN THE UK AND GERMANY

PAT HARRIS
WALTHAM Centre for Pet Nutrition, Leicestershire, UK

A major part of this paper has been kindly reproduced with permission from the article "Review of equine feeding and stable management practices in the UK concentrating on the last decade of the 20th century" as published in Equine vet. J. Suppl 28 p 46-54.

UK

Overview

Equine feeding and stable management practices for horses kept in the UK vary greatly, and it is probable that almost any permutation of regimen could be found somewhere. Unfortunately, there is uncertainty about the number of horses in the UK and very limited data are available on the ways horses are being fed and managed. This paper reviews some of the information that is available and provides an outline of some of the factors influencing the practices used. To a certain extent, the way UK horses are fed and managed primarily reflects the purpose for which they are kept (e.g. racing Thoroughbred vs. native breeding pony), their location (urban vs. rural), the time of year, their breed and age and the owner's financial situation. In very general terms, the various ways that horses can be kept and managed fall between two extremes: the professional riders, owners or trainers who tend to keep horses and ponies in large barns or stable yards managed by themselves or a head stable person and the amateur competitors or leisure riders who tend to keep their horses at a livery yard or at their own home or the home of a friend. Many of these animals are kept under part- or full-time do-it-yourself (DIY) conditions. Common feeding practices range from feeding traditional home cereal-based mixes to feeding coarse mixes or pelleted manufactured feeds. Very few people, however, feed just a simple single grain or compound feed and roughage diet. Many add other feedstuffs and supplements including soaked sugar beet or straight molasses, primarily as palatability enhancers. Other common additions include cod liver oil, various types of vegetable oil, carrots, one or more vitamin and mineral mixes, herbal mixes and certain agents with ergogenic or performance-enhancing claims. Especially for horses used for competition purposes, provision of supplementary salt is common, either by means of a salt block or lick or as an addition to the feed. The soaking of hay, for a variable time period, is another common practice. Although the type and amount of feed fed fundamentally varies according to the workload of the horse, there tend to be marked seasonal variations in feeding practices due to the weather and the availability of pasture.

Introduction

This century has seen the horse change from having important roles in the military, in agriculture and as transportation to becoming part of the expanding leisure industry. This alteration in the fundamental role of the horse has in turn resulted in changes both to the ways horses are kept and managed as well as to who keeps and manages them.

An extensive horse census has not been carried out in the UK since the 1930s when it was estimated that there were 1,278,341 horses (Mellor et al., 1999) . In the 1997 Ministry of Agriculture, Fisheries and Food (MAFF) survey (Anon, 1997), which recorded the number of holdings on which horses were kept and their numbers, there were around 245,000 horses kept on about 39,000 agricultural holdings throughout the UK. This would be an underestimation of the total number of horses in the UK, considering the change in the role of the horse in the last few decades. Records do not take into consideration the number of horses kept on land that is used for purposes other than agriculture. In a fairly large survey carried out also in the mid-1990s for the British Equestrian Trade Association (BETA) by the Produce Studies Group, the estimated number was about twice that of MAFF or 500-600,000 horses (Anon-BETA, 1996; see Table 1). This estimate was revised in the more recent survey to reflect a horse population of one million (Anon-BETA, 1999).

An extensive recent survey (Mellor et al., 1997; Mellor et al., 1999) suggested that in Scotland and northern England more than three times the number of horses were present than recorded by MAFF's annual census conducted in the same area at the same time. The authors implied that if the same ratio were to apply to the whole of the UK the number of horses would be around 800,000.

Even less published information is available on the ways in which horses are being fed and managed throughout the UK. This review therefore brings together some of the information that is available and looks at some of the factors that may influence feeding and management. This review highlights the lack of scientifically reliable information on the feeding and management of the UK horse population, which continues to play an important, if changed, role in our society. Currently, for example, one of the main sources of illustrative information is surveys that have been carried out by various organizations in different segments of the horse industry. The findings from these surveys obviously will have been influenced by the sample groups used. For example, those who ride mainly for pleasure are less likely to feed the recommended amounts of cereal-based feed in the summer when grass is available than those who ride mainly for competitive reasons. For this reason, a guide to the various surveys used to illustrate parts of this paper, and their target groups, are given in Table 1. Even the descriptors of the various equestrian activities used in the surveys are not equivalent.

Table 1. The percentage of the respondents, in a number of surveys, who participated in various equestrian activities.

Activity	Anon-			
	BETA 1996[a]	Equestrian 1995[b]	Eventing 1996[c]	Horse 1997[d]
Riding for pleasure/hacking	74		77	24
Having riding lessons	53			
Exercising the horse	36			
Schooling (the horse, not the rider)	25			
Show jumping	18	37	74	17
Trekking	16			
Dressage	12	35	74	17
Hunting	8	28		
Hunter trials	8			
Eventing (general)	5	29	77	2
Horse trials- unaffiliated				11
Eventing (three-day event)			38	
Eventing (one-day event)			85	
Point-to-point			16	4
Showing			44	20
Shows		42		
Driving			8	6
Sponsored riding	5			
Polo			8	2
Endurance riding			6	6
Others (UK chasers, driving, racing, etc.)	5			
Breeding				6
Buying/selling			35	11

[a] Survey carried out by the Produce Studies Group. This interviewed over 3,000 households with over 7,000 individuals and interviewed 500 horse owners/riders (maximum of one person per household).

[b] Survey carried out on behalf of the IPC Equestrian Group. The results were taken from an Omnibus Study (2,000 face to face interviews of adults aged 16+ years who were selected in a minimum of 130 sampling points at the end of 1994) together with desk research and a self-completion questionnaire sent to 3,000 members of a database of people who had bought or sold equestrian goods or services recently (553 questionnaires returned). 68% of respondents rode for pleasure and 28% worked with horses. For questions such as "where do you keep your horses/ponies" and "approximately how much have you spent in the last 12 months on your horses/ponies," the source of the information was 515 horse/pony owners.

[c] Reader survey was carried out for IPC Magazines Ltd. The data for this survey was gathered by means of a self-completion questionnaire included in an issue of Eventing magazine (August 1996). 245 replies were processed. Just over 3/5 of this sample rode for pleasure; 1/3 were actively involved with equestrian organizations/events, 1/5 worked with horses.

[d] Reader survey was carried out for IPC Magazine Ltd. The data for this survey was gathered by means of a self-completion questionnaire inserted into the launch issue of Horse Magazine (July 1997). A random sample of 1023 completed returned questionnaires was processed.

Factors Influencing Feeding and Management Practices in the UK

Today there is no general feeding or management practice for horses in the UK. It is probable that almost any permutation of feeding regimen can be found somewhere in the UK. In principle, the way UK horses are managed reflects a combination of the purpose for which they are kept, where and how they are kept, time of year, breed and age, and financial circumstances. An indication of how these factors may influence feeding and management practices is provided below.

The purpose for which horses are kept

As in other countries, a Thoroughbred in race training is likely to be kept in an individual stall within a larger complex and is often clipped and rugged with little or no access to grazing. Such an animal would typically be fed several meals a day of an energy-dense, usually cereal-based feed with relatively little of its energy or other nutrient supply coming from forage. This contrasts markedly with the native breeding pony, such as the New Forest pony, which receives little attention from man, eats primarily forage and eats for survival.

Horses kept for hacking or general purpose riding commonly spend part or most of their time out at grass and endurance horses are often fed high forage-based diets supplemented with vegetable oil. Many top dressage and show horses are kept stabled for most if not all of the day. Such general descriptions could continue and yet not apply to many individuals within any particular group. It is also not possible to categorize, even in the broadest sense, according to the purpose for which horses are kept, as not all horses are registered with either a breed society or a discipline-oriented association. It has been estimated that about 600,000 riders take part in some form of competitive riding, although 60% were participants in local competitions only (Anon-BETA, 1999). A proportion of owners and riders compete at a local (unregistered) and/or national (registered) level in a number of disciplines using the same horse. For many uses, such as hunting and polo, there is no formal registration scheme. Many horses are used for hunting during the winter and then for a different purpose in the summer. The Anon-BETA survey of 1999 estimated that 10% of riders hunt. Horses used for competitions or more intensive pastimes such as hunting tend to be kept stabled for prolonged periods of time and to be fed, when in work, some form of concentrate feed in addition to forage. An indication as to the size of the equine competitive industry in the UK is given in Table 2.

In the survey carried out in Scotland (Mellor et al., 1997) the most popular equestrian activities were hacking, involving 24% of the horses, breeding (20%) and use in riding or pony club events (18%). Only 2% of horses kept by respondents were used for endurance riding, and a similar number was kept for point-to-point racing. In the recent BETA survey, it was estimated that about 30% of animals are ponies (Anon-BETA, 1999). In this survey the main uses to which horses were put varied according to whether the respondents were private householders, riding schools and livery yards, breeders or trainers. Riding or hacking, however, was the main category of use overall.

Table 2. Indication of the purpose for which some horses were kept in the UK in 1996.

Discipline/Use		~ Numbers
Horse Trials	Registered	7,500
	Advanced	772
Dressage	Registered	5,700
Show Jumping	Registered	16,200
British Endurance	Registered	950
Horse Driving Trials	Registered	630
Polo	Estimated	7-8,000
	High Goal	1,500
Race Training	Estimated	12-13,000
Thoroughbred mares covered each year including Ireland primarily for racing purposes		22,000
Number of foals born in UK and Ireland to Thoroughbred mares - primarily for racing purposes	Estimated	12,000

Where and how horses are kept

1. Urban vs. rural setting. Horses kept in urban settings are less likely to spend prolonged periods in large paddocks grazing than in rural areas (although it will also depend on other factors discussed in this section). At one extreme of this spectrum would be the urban pony kept in Dublin and at the other extreme would be ponies freely roaming areas such as the New Forest or Exmoor. Unfortunately, no survey has been carried out throughout the UK on this aspect. In one survey (Anon-Equestrian, 1995), it was estimated that about 7% of UK households had a member who rode, although only 19% of these riding households actually owned the horse or pony they rode (~340,000 households) and these were generally located in rural areas. In more recent surveys (Anon-BETA, 1996 and 1999), only an estimation of the geographical distribution of riders (not necessarily owners) was made as shown in Table 3.

Table 3. Regional distribution of riders compared with the national distribution (Anon - BETA survey, 1999).

Region	1999	
	Horse riders	Population
	%	%
Scotland	8	9
North	21	25
W. Mids/ Wales	14	14
E. Mids/ E. Anglia	11	11
South West	9	8
London and South East	37	33

2. DIY vs. livery. The manner in which horses used for riding purposes are kept and managed in the UK falls broadly between two extremes. Firstly, professional riders, owners and trainers tend to keep horses and ponies either in large barns or stable yards managed by themselves or by a head stable person with help from a number of stable lads or grooms. Conversely, there are amateur competitors or leisure riders who tend to keep their horses at a livery yard or at their own home or the home of a friend. Many of these animals are kept under part- or full-time do-it-yourself (DIY) conditions. Full-time DIY would mean that the owner or keeper is responsible for feeding, turnout, grooming and riding. Full livery, on the other hand, means that the livery yard owner or operator does all of this with the owner or rider being able to turn up, usually at his or her convenience, to ride or to compete. The most commonly provided service among professionals who keep other people's horses in the Anon-BETA 1999 survey was full livery. In this survey it was estimated that 83% of all horses and ponies were owned and kept by private households and 7% were owned by private households, but kept by livery yards.

   In the Scottish survey (Mellor et al., 1997), 50% of owners kept their horses on private premises and 50% on shared premises. Whether this would hold true for the rest of the UK, especially the more urban areas, is not known. The results from two surveys shown in Table 4 provide differing data, with 64% keeping their horses on their own land in the 1995 survey and 18% in the 1997 survey. The apparent decreasing trend in the number of people who keep horses on their own land probably reflects the demographic characteristics of people included in each survey and/or the question asked rather than a trend with time.

In the Scottish survey (Mellor et al., 1997), 29% of horses were stabled most of the time and a further 2% were permanently stabled and never given access to grazing.

Table 4. The percentage of respondents to two separate surveys who indicated where their horse(s) were kept and the question that was asked in each survey with respect to this.

Where kept	Anon -Equestrian 1994	Anon -Horse 1997
Livery	12	24
Rent land/stabling	12	20
Own land/stabling	64	18
Livery part-time	5	5
Livery full-time	5	4
Other	7	-
Question asked	Where do you keep your horse/pony?	Where horse(s)/pony(s) usually kept?

3. Single vs. multiple. This section also reflects whether the horse or pony is kept at the person's own home or not. When kept at home, there is an increased likelihood that just one or a few horses will be kept, often with a similar small number of stables. In one survey carried out in the mid-1990s (Anon-Equestrian, 1995) of those households that did own their own horse or pony, 70% owned only one. In a survey carried out into racehorse establishments in Ireland, 57% of the horses were kept in individual single story loose boxes (usually attached to each other in some linear configuration and often sharing air space) and 36% were housed in American-style horse barns (Townson et al., 1995).

Time of year

Each discipline tends to have a competitive season, although for disciplines such as show jumping and dressage the increasing availability of suitable indoor venues has extended the season to almost the whole year. Eventing under the BHTA, for example, runs from March to mid-October although unaffiliated horse trials start in the autumn. Hunting, however, tends to be an autumn and winter sport only. Some horses used only for this purpose may be given the summer off; others may be given a short break and then used for a different purpose.

Seasonal variations in feeding practices occur, mainly due to the weather, and tend to reflect the usage of the animal and the availability of pasture. In the leisure and breeding industries, many animals will be wintered out, often with protective clothing, although many will be brought in at night and fed. Native

animals more commonly winter out, often with the provision of supplemental forage. In the Scottish survey (Mellor et al., 1997) 10% of the animals were permanently kept at pasture (~10,000 horses). In the later BETA survey (Anon-BETA, 1999) it was estimated that around 145,000 horses were kept in the open all year. In the riding schools and livery yards, 23% of horses that were owned by these establishments were stabled all year and 16% kept in the open all year as compared with 29 and 11% of those horses that they kept for others. The most common practice was to keep horses stabled in the winter only.

In the leisure industry, horses used for hacking purposes generally receive more supplemental feed in the winter months than in the summer months when pasture is plentiful. This is reflected in the figures on production of compound feeds for horses supplied by the Ministry of Agriculture, Fisheries and Food (MAFF) statistics (Commodity and Food) Branch A (Harris, 1997a). In 1994, for example, 9.1, 8.9, and 8.8 thousand tonnes (1000 kg) of feed were reported to have been produced in May, June and July respectively, compared with 10, 13.8, 14.9, 15.8 and 15.2 for August, September, October, November and December, respectively. Animals in competitive work and lactating mares tend to continue to be fed intensively throughout the summer months.

Breed, age and individuality

The breed distribution of all horses in the UK is not known but in both the Scottish (Mellor et al., 1997) survey and the Anon-BETA 1996 survey, as shown in Table 5, the most common breeds were Thoroughbred and Thoroughbred crosses.

Table 5. A guide to the breed characteristics of horses in Great Britain based on the Anon-BETA 1996 survey.

Breed	Number x 10^3
Thoroughbred/Thoroughbred crosses	216
Pony - Welsh	87
Pony - Shetland	18
Pony - Other	75
Arab/Anglo Arab	38
All others (includes “don’t know” responses)	132
Total	566 *

* The figure actually given in the survey report is 565,000

In the Scottish survey these represented a slightly lower percentage (30 vs. 38%). Reference has been made previously to the different practices commonly used for the native pony considered to be more hardy than, for example, the less robust Thoroughbred. This is, once again, a generalization. Native ponies kept for showing purposes may be managed intensively and some individual Thoroughbreds may be kept fairly extensively. Breed and individual differences in ability to maintain weight or become overweight will obviously affect feeding and management practices. An individual's susceptibility to certain clinical disorders, especially laminitis, COPD, spasmodic colic and equine rhabdomyolysis syndrome, may also influence the way individuals are fed and managed.

In the Scottish survey (Mellor et al., 1997) the mean (± s.d.) age of the population was 11 ± 7.5 yrs with an equal sex ratio. Anon-BETA 1999 estimated that about 46% of horses and ponies were mares or fillies and amongst the private householders the average horse was about 12 years old. Breed and age together have some influence on the way the animal is kept. In a survey carried out on a number of Irish studfarms (O'Donohue et al., 1995) it was found that mares and young stock usually had access to pasture on almost all farms (n=46) surveyed. In general, animals were housed only during winter and then normally only overnight. The housing regimen varied with the studfarm involved, the age of the animal and time of year. For example, during the latter part of the winter on three farms the animals were not housed at night, yet on 41 studfarms the young stock were housed at night. One studfarm sold all foals during early winter and on another farm the animals tended to be housed almost completely during the latter part of their first winter. Few surveys are available which evaluate, in practice, the amounts and types of feeds fed to animals at various ages. This Irish survey is one of the few to have been published on breeding and young stock providing details on nutritional and management practices.

It is currently accepted by many that horses are living and being kept longer than horses would have been towards the beginning of this century. However, no scientifically published survey has been carried out into any associated changes in nutritional and management practices, although there are increasing numbers of commercially available compound manufactured diets for the senior horse.

Financial circumstances

Few substantial data are available on the cost of owning and competing a horse. The costs vary according to the type of horse kept (e.g. hardy native vs. sensitive Thoroughbred) and the purpose for which it is kept (e.g. general hacking vs. three-day eventing), a variability reflected in Table 6. The costs of keeping horses according to one survey (Anon-Horse, 1997) in which 24% of owners used their horses at least in part for hacking, 11% for unaffiliated horse trials and only 2% for BHTA horse trials, are much lower than those reported in

Table 6. Categorized spending on horse care according to the respondents of four surveys.

Average amount spent £/year[a]	Anon-Equestrian (1995)[b]	Horse Survey (1997)	BETA (1996)[c]	Eventing Survey (1996)[d]
Livery	1,717	1,199		2,254 (27)
Stabling	916	958	505	1,202 (24)
Transport	936	657		995 (46)
Feed	1,172	463	345	965 (56)
Tack	+ Equipment 715	414	115	566 (62)
Shoeing	-	404	195	556 (67)
Vets	620	352	100	479 (66)
Insurance	533	310	90	521 (53)
Equipment	see Tack	211	see Tack	257 (57)
Competing	560	187	70	515 (60)
Security	150	173		305 (13)
Feed Supplements	see Feed	87		305 (13)
Other			Paid help £105	538 (14)
			Dewormers £50 Stud fees £20 Others £25	

Figures in parentheses = proportion spending on this category

[a] Of those stating that they spent on this category

[b] Given as the average spent per person in the last 12 months on their horses/ponies

[c] Based on total expenditure across 565,000 horses and each category includes a varying proportion of horses on which nothing was spent, i.e. average spent per horse, not average amount where spent

[d] Given as the average spent per person in the last 12 months on their horses/ponies includes some expenditure on feed, bedding and other services in bedding costs

another survey (Anon-Eventing, 1996). In this later survey, 85% of the respondents were competing at the one-day event level and 38% at the three-day event level. However, it is interesting that, although 85% said that they were involved with one-day eventing, only 67% reported as having spent money on shoeing. This may reflect that those completing the questionnaire failed to fill out this section or were not aware of how much they spent. Again, this highlights the lack of verified information available. In one survey (Anon-BETA, 1996) it was noted that the cost estimates varied considerably both within and between the different categories of owners. Another complicating factor could be the respondent's understanding of the question and exactly what the various categories referred to (e.g. what each respondent considered to be stabling and/or livery costs).

An alternative way of looking at the situation was reported in 1999. A survey suggested that the total spent in the UK on direct expenditure on horses was £1200m (with a grand total of £1940m), £330m of which was associated with feeding costs (Anon-BETA, 1999).

In the report on lifestyle in one survey (Anon-Equestrian, 1995), it was stated that the sample used was significantly more wealthy than the national average and 62% lived in a detached house compared to the national average of 15%. However, this survey did not evaluate availability of disposable income and what proportion of this disposable income was spent on the horses. Another survey reported that riding had equal appeal across social classes, split evenly between the middle and working classes (Anon-Gallup, 1994). Many owners keep their horses in the best possible conditions that their disposable income allows and for some this means that they take no holidays and buy few new clothes. Any spare money is spent on the horse.

Feeding and Stable Management Practices

There are few published reports of example feeding programs available in the scientific literature for the UK and Ireland and very few have been published in the last decade of this century (Harris, 1997a; O'Donoghue et al., 1995), although examples are provided in a number of the nutrition texts.

The preceding section described some of the general factors that may influence the way horses are kept and managed; some key aspects of management and feeding practices will now be explored.

Types of bedding used

Table 7. Percentage of respondents who used various types of bedding according to three surveys.

Types of bedding used	Anon-Equestrian* (1995)	Anon-Horse** (1997)	Anon-Waltham*** (1997)
Straw	58	41	68
Shavings	48	32	24
Shredded Paper	7	3	4
Hemp	2		
Peat	1		
Rubber Matting			4
[a]Other	7	(24)	

[a] Other included wood chippings, sawdust and rubber matting.

* Numbers did not add up to 100% in this survey as published. Those included in the other group may have included people using hemp, peat or rubber matting.

** In this survey, some respondents noted that they used more than one type of bedding

*** In this survey, details of the predominant or sole bedding used by the respondents were requested.

Straw is not highly regarded as a forage in the UK, especially for young animals with an immature hindgut. It is believed to increase the risk of impactions and chronic obstructive pulmonary disease (COPD). However, as shown in Table 7, straw remains the most frequently used bedding, which may reflect tradition and its availability, relative low cost, and relative ease of disposal, as well as the anthropomorphic perception of straw providing a deep, warm and comfortable bed. In the survey and assessment of racehorses in Ireland carried out in 26 establishments, 65% used straw (twelve yards used straw only); 26% used wood shavings (four yards used wood shavings only) and 9% used shredded paper.

Choice of feed/feed supplier

In one survey (Anon-BETA, 1996) it was estimated that around 65,000 horses were owned by professionals and about 500,000 were owned by private households. What proportion of the decisions over the choice of feed and feed supplier was made solely by the owner is shown in Table 8.

Table 8. A guide as to who makes the sole decision on the choice of feed given to their horse and the feed supplier of this feed according to the Anon-BETA 1996 survey.

	Private owners	Professional owners - horses owned by them	Professional owners - horses kept by them on behalf of others
Choice of feed	59	97	63
Feed supplier	58	98	68

Among private owners, shared decisions (with the keeper) accounted for between 15 and 20% of all decisions.

Types of feed fed

Oats may be the traditional cereal fed to working horses (Harris, 1997), but in the UK oats are also considered to be a psychologically heating feed. Therefore, horses predominantly in light work are more likely to be fed cool mixes or non-heating products which are oat-free. This is illustrated by the low number of horses in a small survey (Table 9) being fed oats (Anon-Waltham, 1997 unpublished data).

Table 9. The percentage of respondents who stated they fed each type of feed listed below according to two surveys.

Types of feed	Anon-Equestrian (1995)	Anon-Waltham (1997)
Hay/hay substitute	85	86
Grass	76	85.5
Premixed feed	72	66
Traditional feed	48	17% fed oats &16% fed barley
Other	4	

Traditional feed in the Anon-Equestrian 1995 survey is taken to refer to an oat or other cereal-based diet.

Ninety percent of the respondents described their winter feeding program, 78% of whose horses were in light work, 19.5% in medium work and 2.5% in hard work. All horses were 4-20 years old inclusively and ranged in size from 13.2 hands and above, with 50% greater than 14.2 hands and less than 16 hands.

Barley is generally fed rolled or cooked to increase small intestinal digestibility. **Maize** is generally micronized or flaked before feeding. It is not commonly fed cracked. Traditionally, **wheat** has not been fed as a straight cereal to horses in the UK. However, the more modern cooking processes allow it to be used as a high energy feed in compound coarse mixes and home-mixed cereal rations.

Appropriately treated **soya bean** may be added in some form or another as a source of essential amino acids. The expelled meal and full-fat meal are often fairly unpalatable and therefore the full-fat flake, which has usually been micronized, tends to be the form that is sometimes used as a top dressing to balance "cereal straights."

The use of premixed or compound manufactured feeds has increased in the UK over the last few years (Harris, 1997a; 1998). The O'Donohue survey (1995) suggested that, even on studfarms, there is a greatly reduced dependence on completely home-compounded diets in the 1990s compared with the 1960s (McCarthy, 1975). The compound feed market is becoming increasingly fragmented with the development of many smaller niche markets such as the veteran animal and the convalescent animal. The major companies tend to have a wide range of feeds for different life stages and exercise types and offer the feeds in a number of different forms. This may reflect the feeding trends within the growing leisure section of the horse market in which the individual owner wishes to feed a diet specifically targeted to its animal's needs. However, the bulk of the feed sold still tends to be the general maintenance or light work cube and mixes.

Most feed manufacturers guarantee their products are free from caffeine and theobromine and are therefore suitable for animals competing under FEI or Jockey Club rules.

For maintenance, light work or breeding, **nuts, pellets/cubes** varying in size from 2 to 15 mm diameter are still very popular. Forty-six percent of the respondents in one survey (Anon-Waltham, 1997; unpublished data) fed cubes, but often in combination with coarse mixes (sweet feeds, a mixture of processed cereals often combined with molasses or glucose syrup and other ingredients such as grass nuts, sugar beet pellets and protein, mineral and vitamin balancing pellets).

Alfalfa hay is not as commonly fed in the UK as in countries such as the United States because it is usually imported. Its regular use is limited to some of the racing yards and breeding studs. However, alfalfa chaffs are being fed increasingly as part of the diet and are often mixed with the concentrate portion in order to provide bulk and to slow the rate of eating. Seventy-four percent of the respondents in one survey (Anon-Waltham, 1997; unpublished data) fed chaff (short chopped hay, straw, alfalfa or mixes).

Chaff is commonly added to concentrate in the UK. The amounts vary but commonly about 0.5 kg per feeding is included. There are four main types of chaff available in the UK: molassed straw chaffs which contain around 40-

60% molasses and straw, (+/- limestone); high temperature dried alfalfa with 10-20% molasses; a straw and alfalfa 50:50 mix; non-molassed pure hay and straw chaffs (see Table 5). Homemade chaff is still fed, but mainly in larger yards.

Another common component of horse feeds in the UK is sugar beet pulp (a by-product of sugar beet processing). It is usually molassed and is largely purchased as dehydrated shreds or compressed pellets which are then soaked before use. In one survey (Anon-Waltham, 1997; unpublished data) 47% of respondents regularly fed soaked sugar beet pulp. Wheat bran usage appears to be on the decrease, although it is still fed under more traditional feeding regimens (this is a personal observation and due perhaps, in part, to the increased awareness of the reversed calcium to phosphorus ratio). Only 11% of the respondents regularly fed bran in the Anon-Waltham 1997 survey.

Grass is a major component of the diet of most horses according to the surveys shown in Table 9.

In the Scottish survey (Mellor et al., 1997), 69% of horses grazed at least half of their time, with 10% permanently grazing and only 2% never grazing. Pastures vary in their composition not only from region to region but also from season to season. Calcium levels, for example, can decrease significantly during the winter when the calcium to phosphorus ratio may become reversed. Certain geographical areas may have pastures deficient in certain trace elements, particularly copper, zinc, manganese and/or selenium. Therefore, it is important to appreciate which areas are likely to be deficient, especially if the pasture is the main source of nutrients (Harris, 1997). Standard grazing levels vary; the commonly recommended rule of thumb is two acres for the first animal and then one acre for each subsequent animal, depending obviously on whether the pasture is the sole source of nutrients.

Feeding of supplements or feed additives

Very few horsemen provide their animal with a simple, single cereal or compound feed and roughage diet. Separate feedstuffs and various supplements and additives are commonly provided. In one survey (Anon-Equestrian, 1995), the respondents were asked whether they used feed additives or supplements. Fifty percent of respondents regularly fed supplements and were more likely to be males in the younger age groups, 36% said supplements were fed occasionally and 10% did not feed supplements. Various feed additives and supplements can be given to horses. One of the difficulties with surveys is defining what an individual considers to be a supplement or a feed additive. Carrots and apples are commonly given to horses as succulents, but are they considered to be supplements or normal feed components? Sixty-two percent of the respondents in the Anon-Waltham 1997 survey said they fed succulents. Salt is often available as a lick or rock in the horse's box or manger and is usually required to provide the sodium and chloride necessary for the horse, especially those which sweat extensively and regularly. Some respondents may have included salt as a supplement and others may have included salt as part of the normal diet. This highlights once again the need for a properly constructed survey.

The more commonly accepted supplements range from the broad spectrum vitamin and mineral supplements to those providing one or a selected few specific nutrients. Supplemental vegetable oil is often fed as an alternative or additional energy source (Harris, 1997b). In addition, herbal mixes, digestive aids, ergogenic aids, calming agents and coat conditioners are also available. Many supplements are, unfortunately, given with little knowledge of their suitability to be fed with the basal diet constituents or with other supplements in use. Often there is little understanding of their efficacy. This can sometimes lead to oversupplementation of certain nutrients with possible interactions and interferences (Harris, 1997a). Treats are often given to horses in the UK but the extent may depend on what is classified as a treat. Carrots, apples and mints are often used as rewards. Specifically manufactured treats for horses often include herbs or peppermint and are readily available.

Hay feeding practices

A variety of **hay** types is available in the UK, including meadow, seed and legume hays. Hays will differ in the number and type of grass species present, which in turn will affect the protein, mineral and energy levels, as will the stage of growth when harvested and the area where it was grown.

Hay quality can be variable in the UK due to unpredictable weather conditions; hay often tends to be dusty with a high fungal spore count. Several different methods have been used to deal with this, and there has been an increase in the use of alternative forage sources for horses, in particular big bale **haylage** (>40% DM) and **silages** (<40%DM). **Barn dried hay** is made from grass that is allowed to wilt in the field for two to three days when weather conditions are conducive and then loosely packed into special buildings where air of a particular temperature and humidity is blown through it for eight to ten days before it is baled.

Both commercial and home-produced haylages are made. The homemade varieties tend to vary considerably in composition. In the commercial production of haylages, plants are wilted to approximately 50-60% DM and placed into semi-permeable plastic packages where mild anaerobic lactic fermentation occurs, which stabilizes at a pH of approximately 4.5 -5.5. These haylages tend to have a protein level of 9-12 % and a DE value of 9-11 MJ/kg. Because of the high moisture content of the haylages, the fiber level is comparatively low (MAD ~32 -36%), so if fed at the same inclusion rate as hay may potentially result in problems due to a lowered fiber intake. There are concerns with feeding haylage, especially with respect to potential clostridial activity and lowered overall fiber intake, but the demand for haylage appears to be increasing. Once again, the extent of the increase depends on the participants in any particular survey. For example, only 3% of the 86% of respondents that fed forage in one survey (Anon-Waltham, 1997; unpublished data) fed haylage.

The practice of soaking hay to increase the likelihood of fungal spores adhering to the forage and being ingested rather than inhaled is popular. In the Anon-Waltham 1997 survey, 28% of respondents soaked their hay. The water

used for soaking must be fresh, and although there is still some discussion over exactly how long soaking should be carried out, the author recommends soaking no longer than one hour because of the potential negative effect of prolonged soaking on the soluble carbohydrate and nitrogenous content of hay (Warr and Petch, 1992; Harris, 1997a). In the Irish studfarm survey, only 2 of the 26 establishments routinely soaked their hay, but all of the trainers surveyed replied that they would soak hay for individual animals when required and for the whole yard if the quality of the hay necessitated such a procedure.

In 1994, Brown and Powell Smith reported that many people in the UK preferred to feed hay on the stable floor. This was endorsed by Townson's survey of a number of Irish racing stables (Townson et al., 1995) which noted that 57% of the stables fed hay from the floor. However, in one survey (Anon-Waltham, 1997; unpublished data) of those who fed hay, 90.5% fed from a hay net. Suggested disadvantages of hayracks or nets high off of the ground included an increased risk of particles getting into the eyes and nose and feet getting caught in the rack or net. Eating from a high rack or net is thought to be an unnatural feeding position and suggested by some to affect muscles and nerve function adversely (Hintz, 1997). Hayracks at chest height are thought to increase the risk of injuries, decrease the space available within the stable and are costly. Although hay feeding on the floor induces a more natural feeding posture, it increases wastage, partially by increasing the risk of contamination with feces and urine. In addition, there is an increased risk of parasite egg ingestion.

Forage to concentrate ratios

Information for this composite table (Table 10) has been provided from a number of horse feed manufacturers in the UK in order to obtain a representative picture (Baileys, Dodson & Horrell, Spillers and Winergy).

Table 10. A guide to the amounts of forage and concentrates fed in the UK according to a number of nutritionists.

This is only a very approximate guide, as the actual ratios fed to a horse will vary according to a number of factors including the individual horse, the relative work intensity for that individual and therefore energy requirement, the rider/owner's requirement with respect to body condition and type of riding, the forage that is available, the actual forage and the concentrates being fed, the breed, the environmental conditions and management practices. With respect to young stock, growth rates, sales preparation, race training, and work intensity must also be considered.

Type of Animal	% of Body weight on an as fed basis Figures in bold italic refer to ratios of feed		
	Forage	Concentrates	Total
Mature horses at maintenance	2 1.5 -1.8 1.5 -2 ***95***	0 0.2 - 0.5 0 - 0.5 ***5***	2 2 1.75 - 2
Mares - late gestation	1.2 1.4 -1.8 1.5-2.0 ***non-TB 80*** ***TB 40***	0.8 0.26 - 0.6 0.25-0.75 ***non-TB 20*** ***TB 60***	2 2 - 2.25
Mares - early lactation	1.5 1.5 1.5 - 1.75 ***non-TB 80*** ***TB 40***	1 1.5 1 - 1.5 ***non-TB 20*** ***TB 60***	2.5 3 2.5 - 3
Mares - late lactation	1.4 1.5 - 1.75 1.25 - 1.75 ***non-TB 90*** ***TB 50***	0.6 0.75 - 1.0 0.75 - 1.25 ***non-TB 10*** ***TB 50***	2 2 - 2.5 2 - 2.5
Light work	1.4 1.5 - 1.8 1.5 - 2.0 ***90***	0.6 0.2 - 0.6 0.1 - 0.75 ***10***	2 2 1.75 - 2.25
Moderate work	1.5 1 1 - 1.5 ***80***	1 1 0.5 - 1.0 ***20***	2.5 2 2 - 2.5
Intense work	1.25 1 - 1.25 0.75 - 1.5 ***50***	1.25 1.25 - 1.5 1.25 - 1.5 ***50***	2.5 2.5 2 - 2.75
Dressage Racing - flat	- 1 - 1.5 0.6 1-1.25 ***40***	- 0.5 - 1 1.4 - 1.9 1.25 - 1.5 ***60***	2.5 2 2 - 2.5 2 - 2.5
Racing National Hunt	0.6 1.25 ***50***	1.4 - 1.9 1.25 ***50***	2.5 2 - 2.5
Show jumping	1.5 - 1.75 1.2 ***80***	0.75 - 1 0.8 ***20***	2.5 2
Eventing	1.5 1.25 - 1.5 ***70***	1 1 - 1.25 ***30***	2.5 2 - 2.5
Hunting	1.5 - 1.75 1 - 1.2 ***50***	0.75 - 1.0 0.8 - 1 ***50***	2.5 2
Weanling - 6 months (TB)	0.75 ***40***	1.75 ***60***	2.5
Weanling - 6 months (non-TB)	1 ***50***	1.5 ***50***	2-2.5
Yearling - 12 months (TB)	1.2 1 - 1.2 ***50***	0.8 0.8 - 1.0 ***50***	2 2
Yearling - 12 months (non-TB)	1.2 1 - 1.2 1.25 - 1.5 ***70***	0.8 0.8 - 1.0 0.5 - 1.0 ***30***	2 2 2 - 2.25
Long Yearling (TB)	1.2 1.25 - 1.5 ***50***	0.8 1 - 1.25 ***50***	2 2 - 2.5
Long Yearling (non-TB)	1.2 1.4 ***70***	0.8 0.6 ***30***	2 2
Two-year-old (TB)	1.4 1.4 1.0 - 2.0 ***40 Racing***	0.6 0.6 0.5 - 1.0 ***60***	2 2 2 - 2.5
Two-year-old (non-TB)	1.4 1.5 1.25 - 1.75 ***80***	0.6 0.5 0.5 - 0.75 ***20***	2 2 2 - 2.25

Frequency of non-forage/roughage feeding

Most owners or managers feed at least once or twice a day when concentrate or hard feed is given. For animals with high energy requirements (such as horses in some racing, hunting or eventing yards), feed may be divided into three or more meals a day in order to provide sufficient energy while minimizing the risk of digestive disturbance. In one survey (Anon-Waltham; 1997; unpublished data) in which 78% of the horses were in light work, 14% were fed once a day, 80% were fed twice a day and 6% were fed three times a day.

Examples of Feeding Practices

A survey of a few top horses in a number of disciplines suggested that these animals, apart from the advanced dressage horses, were being fed less energy than the NRC requirements (Hollands, 1995). Only the advanced dressage and novice event horses were being fed slightly more than the NRC requirements for protein, and all were being fed far more than the NRC requirements of calcium, magnesium, phosphorus and potassium. Sodium intakes tended to be at or slightly lower than NRC recommendations, although the survey did not include the effects of any additional vitamin or mineral supplementation. Copper and iron levels tended to be higher then recommended. Iodine and cobalt levels were far higher than NRC stated levels as were vitamin A and D levels. Vitamin E levels prior to supplementation were approximately the same as NRC recommendations as was manganese, zinc and selenium content in most cases.

The results of a survey carried out on the feeding practices of a number of studs in Ireland are given in Tables 11-13. The mean nutrient intakes (using estimated pasture intakes) were compared against calculated NRC requirements for a pregnant mare, a ten-month-old foal and a 17-month-old yearling. For the mare and foal, the nutrient intake exceeded requirements in all cases. In the weanling, mean intakes of protein and lysine were deficient at the lower dry matter intake and marginal at the higher intake.

Table 11. Concentrate feedstuffs used on a number of Irish stud farms and percentage of stud farms on which feed was routinely used (O'Donohue et al., 1995).

Type of concentrate feedstuff	Pregnant mare	Short yearling	Long yearling
	% of farms n = 46	% of farms n = 45	% of farms n = 44
Straights			
Barley	6.5	6.7	2.3
Dried sugar beet pulp	21.7	20	11.4
Maize flaked	4.3	4.4	6.8
Molasses	17.4	17.8	20.5
Oats	84.8	82.2	72.7
Wheat bran	47.8	42.2	47.7
Grass meal	2.2	2.2	2.3
Linseed/flaxseed	2.2	4.4	2.3
Milk	0	0	2.3
Soya bean meal	28.3	20	20.5
Commercially compounded feeds			
Complete feeds	0	0	2.3
Oat replacer feeds	60.1	60	78.6
Balancers/conditioner	21.7	28.9	36.4

Pregnant mare expected foaling date April 1, as fed February 1.
Short yearling colt born April 1, as fed 10 months of age on February 1.
Long yearling colt born April 1, as fed 17 months of age on September 1.

Table 12. Mean (+/- SEM) weight of concentrate feed fed to a pregnant mare (expected foaling date April 1) or a lactating mare (foaled January 15) based on questionnaire results from a number of Irish studs (O'Donohue et al., 1995).

	Pregnant	Lactating
Month	Mean +/- SEM (kg/day) based on air-dried feed	Mean +/- SEM (kg/day) based on air-dried feed
August	0 +/- 0	-
September	0.3 +/- 0.19	-
October	0.9 +/- 0.28	-
November	3.5 +/- 0.42	-
December	5.0 +/- 0.37	-
January	5.6 +/- 0.32	7.7 +/- 0.41
February	6.0 +/- 0.29	7.7 +/- 0.4
March	6.1 +/- 0.29	7.5 +/- 0.4

Table 13. Mean (+/- SEM) weight of concentrate feed fed to a weaned foal or to a yearling (colt born on April 1) based on questionnaire results from a number of Irish studs (O'Donohue et al., 1995).

	Month	Mean +/- SEM (kg/day) based on air-dried feed	Number of stud farms from which feed weights were collected. Includes farms which did not feed concentrates.
Weaned foal	August	2.5 +/- 0.3	6
	September	2.1 +/- 0.22	32
	October	2.6 +/- 0.18	42
	November	3.2 +/- 0.17	44
	December	3.7 +/- 0.17	44
Yearling	January	4.0 +/- 0.21	43
	February	4.3 +/- 0.22	45
	March	4.2 +/- 0.25	41
	April	3.4 +/- 0.28	41
	May	1.4 +/- 0.27	44
	June	1.2 +/- 0.22	44
	July	2.4 +/- 0.36	42
	August	5.7 +/- 0.42	41
	September	7.9 +/- 0.46	45
	October	8.5 +/- 0.41	42

Comparison with Germany

There are approximately 1.5 million riders and 600,000 horses in Germany. In 1994 the German Sports Club registered 665,000 members (35% male, 65% female) in German riding clubs, and it has been estimated that the number of non-organized riders is similar to this. In addition, there are around 800,000 hobby riders taking part in vaulting, riding school activities and pleasure riding. The popularity of western and Iberian riding continues to increase.

The number of Thoroughbred broodmares in Germany was about 2,500 in 1990 with approximately 2,400 races held on a total of 49 racetracks. In 1994, the estimated number of Thoroughbred broodmares was 7,000 and there were close to 3,000 races held. Unlike the UK and Ireland, trotting races are very popular in Germany. The most important breed in Germany is the German riding horse. The numbers of these have also increased. There were around 53,000 registered broodmares and 2,000 stallions in 1990 with around 80,000 and 3,000 respectively in 1994. All German riding horse breeding stallions must be licensed and have undertaken and passed a performance test at the age of 3 or 4 years.

A fairly recent survey of over 200 people, predominantly private horse owners, representing 735 horses was carried out in Germany. This survey

involved participants from all over West Germany, although the majority came from the northern areas. Some of the findings are shown in Tables 14 and 15. The survey covered a wide number of breeds, ranging from the Shetland to the Hanovarian. As in the UK, most of the riders were female. In the UK survey, riding was most popular for women between 16-24 years of age, while in the German survey around 78% of the female participants were between 21 and 40. A slight increase in the number of male riders in the UK had been seen between 1992 and 1994, mainly due to an increase in riders between the ages of 25 and 34. In Germany, around 70% of the male participants were between 31 and 50 years of age.

Table 14. How horses were kept according to a recent survey in West Germany.

Livery	22%
At a riding club	13%
Individual stabling	54%
Misc. (including agricultural farms)	11%

Table 15. Age and sex distribution of horse owners surveyed recently in West Germany.

	Total Number	
Age	Male	Female
Up to 20	2	18
21-30	6	82
31-40	17	52
41-50	20	18
50 and up	8	3

In a survey completed in Germany, it was estimated that around 50% of horses were kept in privately owned small stables. Around one-third were kept at riding clubs and pension stables, 10% at farmers and around 15% at neighbors or friends. Although riding clubs (where a number of animals are kept at one establishment and managed by one individual) do appear to be much more common in Germany than in the UK, it was still estimated that only 11% of horses resided in stables with more than 30 horses. There are around 6,000 riding clubs in Germany. Horses are commonly kept in stalls and not turned out to pasture unless they are mares and foals or young stock under the age of three. The young stock often live in group stalls during the winter and are let out to pasture if the ground is suitable or turned loose into the indoor arena for exercise. Horses in competition training tend to be kept inside and take most, if not all, of their exercise in the indoor arena, although many barns or yards, especially if run by the top riders and trainers, do also have a small outdoor sand arena. Loose schooling in the indoor arena is quite common especially with the young stock. Deep littering is

perhaps more commonly practiced in Germany than in the UK and straw is therefore the most common bedding material used, although shavings are becoming increasingly popular.

According to one German survey, about 60% of owners were responsible for feeding horses, but only around 15% of those owners with horses in riding clubs or pension stables have this responsibility. This is similar to UK statistics.

In Germany most of the feedstuffs seem to be bought via agricultural trading companies, although veterinarians are a fairly common source especially for the speciality feeds.

Oats tend to be the major cereal fed to horses in Germany. It has been estimated that oats have around 19% of the feed market share, roughages around 43% and compound manufactured feeds around 35%. Of the processed feeds, pellets have been suggested to have the largest share of the market value (see Table 16 for a comparison with the estimated expenditure in the UK). The rule of thumb for feeding, which is often quoted, is 1 kg oats and 1 kg of roughage per 100 kg body weight. In the larger liveries, riding clubs and stables, oats may be kept and distributed via silos rather than individual bags. Straw is more commonly fed to horses (especially warmbloods) often as a means of lowering the nutrient intake whilst still providing bulk and fiber. Horses in hard competition are commonly fed a competition coarse mix or pellet in addition to the oats. Alfalfa and chaff are fairly uncommon feedstuffs in Germany. The use of salt blocks as well as the addition of salt to the feed appears to be far less commonly practiced in Germany than in the UK.

Table 16. Distribution according to product type according to a UK survey (Anon- BETA, 1999).

Feeds	Estimated direct expenditure per year (£m)
Manufactured feeds	165
Oats and other “straights”	25
Vitamins, minerals and other	30
Hay and/or haylage	110

A guide to the recommended roughage to concentrate feeding ratios is given in Table 17. Concentrate feeds in Germany can be taken to mean vitamin and mineral supplements or similar feedstuffs rather than energy providing, non-forage feedstuffs as referred to in this table.

Acknowledgement

The author thanks the various discipline governing bodies for information supplied by them for Table 2 and the various providers of the Anon survey results.

Thanks are particlarly given to the various nutritionists working for a number of major UK feed manufacturers who assisted with the compilation of Tables 10 and 17, including Liz Bulbrook of Baileys, Teresa Hollands of Dodson & Horrell, Ruth Bishop of Spillers plus Annette Sommerhoff and Linda Mars of Winergy.

Table 17. A guide to the amounts of forage and concentrates fed in Germany.

This is only a very approximate guide, as the actual ratios fed to a horse will vary according to a number of factors including the individual horse, the relative work intensity for that individual and therefore energy requirement, the rider/owner's requirement with respect to body condition and type of riding, the forage that is available, the actual forage and the concentrates being fed, the breed, the environmental conditions and management practices. With respect to young stock, growth rates, sales preparation, race training, and work intensity must also be considered.

Type of Animal	% of Body weight on an as fed basis		
	Forage	Concentrates	Total
Mature horses at maintenance	1.5	0.25	1.75
Mares - late gestation	1-1.5	0.75-1.25	1.75 - 2.75
Mares - early lactation	1-1.5	0.8 - 1.5	1.8 - 3.0
Mares - late lactation	1-1.5	0.75 - 1.25	1.75 - 2.75
Light work	1-1.5	0.5- 0.75	Up to 2.25
Moderate work	1- 1.5	0.5 - 1.0	Up to 2.5
Intense work	1-1.5	0.7 - 1.75	Up to 3.25
Racing - flat	0.8 - 1.25	1.25 -1.5	2- 2.75
Weanling - 6 months (non-TB)	1	1.0 - 2.0	2.0 - 3.0
Yearling - 12 months (non-TB)	1-1.5	1.0	2-2.5
Long Yearling - (non-TB)	1-1.5	0.5 - 0.8	1.5-2.3
Two-year-old - (non-TB)	1.5 -2.0	0.5-1.0	2 -3.0* depends if in work

References

Anon (1997) The Agricultural and Horticultural Census conducted annually by the Ministry of Agriculture, Fisheries and Food.
Anon-BETA (1996) Survey undertaken by the Produce Studies Group.
Anon-BETA (1999) Survey undertaken by the Produce Studies Group.
Anon-Equestrian (1995) Survey undertaken for the IPC Magazines Ltd.
Anon-Eventing (1996) Survey undertaken for the IPC Magazines Ltd.
Anon-Gallup (1994) Gallup Omnibus Survey.
Anon-Horse (1997) Survey undertaken for IPC Magazines Ltd.
Brown, J.H. and Powell Smith, V. (1994) Horse and Stable Management, Blackwell, London. p 16.
Harris, P.A. (1997a) Feeds and feeding in the United Kingdom. In: Current Therapy in Equine Medicine, Ed: N.E. Robinson, W.B. Saunders, Washington. pp 121-124.
Harris, P.A. (1997b) Energy sources and requirements of the exercising horse. Annual Reviews of Nutrition 17. p 185-210.
Harris, P.A. (1998) Developments in equine nutrition: Comparing the beginning and end of this century. J. Nutr. 128, 2698S-2703S.
Hintz, H.F. (1997) Hay racks vs feeding hay on the stall floor. Equine Pract. 19, 5-6.
Hollands, T. (1995) Feeding the three-day event and dressage horse. In: Recent Advances in Equine Nutrition. Proceedings from the KER Equine Nutrition Conference. pp 163–177.
McCarthy, D.D. (1975) Survey of Thoroughbred Stud Farms in Ireland. An Foras Taluntais, Dublin. pp 1-145.
Mellor, D.J., Love, S., Gettinby, G. and Reid, S.W.J (1999) Demographic characteristics of the equine population of northern Britain. Vet. Rec. 299-304.
Mellor, D.J., Love, S., Reeves, M.J., Gettinby, G. and Reid, S.W.J. (1997) A demo graphic approach to equine disease in the northern UK through a sentinel practice network. Epidemiol. Sante Anim. 31-32.
O'Donohue, D.D, Smith F.H. and Strickland, K.L. (1995) Feed intakes on Irish Thoroughbred stud farms. In: Proceedings of the Equine Nutrition and Physiology Society, California. pp 229-234.
Townson, J., Dodd, V.A. and Brophy, P.O. (1995) A survey and assessment of racehorse stables in Ireland. Irish vet. J. 48, 364-372.
Warr, E.M. and Petch, J.L. (1992) Effects of soaking hay on its nutritional quality. Equine vet. Educ. 5, 169-171.