FEEDING AND DRINKING BEHAVIOR OF MARES AND FOALS WITH FREE ACCESS TO PASTURE AND WATER

Sharon L. Crowell-Davis, Katherine A. Houpt and Joyce Carnevale

Cornell University, Ithaca, NY 14853

Summary

The feeding and drinking behavior of 11 mares and 15 foals living on pasture with free access to water was recorded during 2,340 15-min focal samples taken over 2 yr. Lactating mares on pasture spent about 70% of the day feeding. Foals began feeding on their first day of life. As they grew older, they spent progressively more time feeding, but still spent only 47 ± 6% of the time feeding by 21 wk of age. Foals fed primarily during the early morning and evening. While grass formed the major proportion of the diet of both foals and mares, they also ate clay, humus, feces, bark, leaves and twigs. Almost all feeding by foals was done while their mothers were feeding. Movement to water sources was frequently, but not invariably, carried out by an entire herd. Frequency (P=.005) but not duration (P>.05) of drinking bouts by mares increased as the temperature increased. Frequency was greatest at 30 to 35 C, at which temperature mares drank once every 1.8 h. Frequency of drinking varied with the time of day (P<.01), being rarest during the early morning (0500 to 0900 h eastern daylight time) and most frequent during the afternoon (1300 to 1700 h). Drinking by foals was very rare. The youngest age at which a foal was observed to drink was 3 wk, and 8 of 15 foals were never observed to drink before weaning.

Introduction

Adult equids spend more time feeding than in any other category of behavior (Tyler, 1972; Duncan, 1980; Keiper and Keenan, 1980). Foals begin feeding on adult food sources, primarily grasses, as early as the first day of life and subsequently develop adult time budgets for feeding as they grow older (Tyler, 1972; Blakeslee, 1974; Boy and Duncan, 1979).

Horses require 20 to 76 liters of water a day, depending on the type of horse and the prevailing meteorological conditions (Hinton, 1978). Among equids living in free-ranging, feral or wild conditions, there is great variation in the frequency and time of day at which drinking occurs. They drink during the day or night. The frequency of drinking ranges from several times a day to only once every 2 d (Pellegrini, 1971; Joubert, 1972; Blakeslee, 1974; Feist and McCullough, 1976; Keiper and Keenan, 1980).

The concurrent feeding time budgets for mares and their foals were examined in order to determine whether there was a maternal influence on the development of a foal’s feeding time budget. Drinking behavior was studied to evaluate the influence of age class and environmental temperature on the drinking behavior of ponies living on pasture with free access to water.

Experimental Procedure

The feeding and drinking behavior of 11 adult Welsh pony mares and 15 foals (11 fillies and four colts) was recorded during 585 h of focal samples (Altmann, 1974) collected over 2 yr. Four mares foaled during both years of the study. A day was divided into four time periods: 0500 to 0900, 0900 to 1300, 1300 to 1700 and 1700 to 2100 h eastern daylight time. Each week, two 15-min focal samples were collected.

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2 College of Veterinary Medicine, Univ. of Georgia, Athens 30602.

3 New York State College of Veterinary Medicine, Cornell Univ., Ithaca, NY 14853.

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at random times within each time period on each mare-foal pair, for a total of eight 15-min samples/pair⁻¹.wk⁻¹. If circumstances (e.g., illness of a subject) prevented collection of one or more of the eight scheduled samples, all available samples were used for analysis. Pairs were observed until the foal was weaned at 19 to 24 wk of age, except for one pair that could only be observed to 7 wk.

During a focal sample, a continuous record was kept of behavioral states that lasted at least .03 min. Transitions to states that lasted less than .03 min were not recorded. The complete and mutually exclusive list of behavioral states was feeding, drinking, resting upright, resting recumbent, nursing, mutual-grooming, self-grooming, playing and active. A pony was considered to be in the state of feeding if it was taking food into its mouth or chewing it. Food included grass, grain, hay, leaves, feces, soil, twigs, bark and flowers. Licking salt and nursing were not included in the category of feeding. The period between the time a pony first began sipping water until it raised its lips away from contact with the water was recorded as a single drinking bout. A trip to a water source was defined as movement that resulted in a pony being immediately next to a water source and engaging in at least one drinking bout. A pony was defined as resting upright if it was standing still with any two of the following behaviors occurring: one hind limb flexed, ears turned to the side and partly lowered, lower lip flaccid, eyes partly or fully closed. A pony was defined as active if it was not in any of the other states. Usually, this meant it was standing alertly, or walking, trotting or cantering from one site to another.

The ponies were maintained primarily on pastures that contained numerous ponds and streams so that a pony was never farther than approximately 345 m from an accessible water source. The pastures were primarily grassland, but also had sections of forest or other shelter, e.g., shed or barn wall. The primary available food sources were Kentucky bluegrass (Poa pratensis), bermudagrass (Cynodon dactylon), orchardgrass (Dactylis glomerata), bromegrass (Bromus inermis), red clover (Trifolium pratense), alfalfa (Medicago sativa), white Dutch clover (Trifolium repens) and birdsfoot trefoil (Lotus corniculatus). For detailed maps of the study site, see Crowell-Davis (1983).

There were 2,340 focal sample sessions of the behavior of 11 mares and an equal number of the behavior of 15 foals because a mare and her foal were observed simultaneously. Data for the four mares that foaled during both years of the study were evaluated separately for each year. During 17 of the sessions, the ponies were in a pasture that had no natural water source, and they were watered via buckets that were brought periodically. Data for these sessions were not used to evaluate drinking behavior. The time and the state for all transitions of state by the mare and the foal for wk 1, 5, 9, 13, 17 and 21 were entered as computer files on an IBM 360 computer, so that 48 samples/dyad could be analyzed in detail. The total feeding time and time-of-day feeding time for each mare and foal and the feeding time for each foal when its mother was feeding (conditional feeding time) were then calculated for these weeks. The ambient temperature was recorded at the end of 2,241 of the focal samples that were used to evaluate drinking behavior. Frequency and mean duration of drinking were tested for correlation with temperature using Kendall's Tau (Daniel, 1978).

Results and Discussion

Feeding. Foals were observed to feed as early as d 1 and spent 8.1 ± 1.5% of the time feeding during wk 1. As they grew older, the total percentage of time spent feeding steadily increased so that they spent 46.6 ± 6.0% of the time feeding by wk 21 (figure 1). These values are similar to those obtained by Tyler (1972) for New Forest pony foals, which spent 6% of the time grazing during wk 1 and 42% of the time grazing during wk 21 to 24. The observations on New Forest pony foals were made between 0600 and 1800 h. Boy and Duncan (1979), observing foals during 24-h watches, also found that foals began feeding during their first few days of life and subsequently showed a steady increase in the percentage of time spent feeding, although they did not give exact figures.

Overall, mares spent about 70% of the time feeding. The lowest percentage of time spent feeding steadily increased so that they spent 46.6 ± 6.0% of the time feeding by wk 21 (figure 1). These values are similar to those obtained by Tyler (1972) for New Forest pony foals, which spent 6% of the time grazing during wk 1 and 42% of the time grazing during wk 21 to 24. The observations on New Forest pony foals were made between 0600 and 1800 h. Boy and Duncan (1979), observing foals during 24-h watches, also found that foals began feeding during their first few days of life and subsequently showed a steady increase in the percentage of time spent feeding, although they did not give exact figures.

Overall, mares spent about 70% of the time feeding. The lowest percentage of time spent feeding by mares, 57.2 ± 4.4%, occurred during wk 13, which fell in June for one mare, July for six mares and August for seven mares (figure 1). This coincided with a peak in the percentage of time spent resting upright, as mares spent many of the hot hours of the late morning and afternoon resting in shady or breezy areas. In a
study of feral horses in western Alberta, Salter and Hudson (1978) observed a decrease in diurnal feeding time in open habitats during the summer with a concurrent increase in sightings of their subjects in shady, forested habitats. The mares may have compensated for their decreased diurnal grazing activity by increasing their nocturnal grazing activity. Keiper and Keenan (1980) found that feral ponies spent 32.8% of the night grazing during June, July and August. Duncan (1980), whose data on Camargue horses were based on 24-h watches, reported that adult mares spent 58.5 to 59.5% of the time foraging during the spring and summer and 61.7 to 63.1% of the time foraging in the fall and winter.

There was some variation among the developmental time budget of foals depending on the time of day. The foals exhibited an increase in the percentage of time spent feeding during all time periods. However, a greater increase occurred during the early morning (0500 to 0900 h) and evening (1700 to 2100 h) than occurred during the late morning (0900 to 1300 h) and afternoon (1300 to 1700 h; figure 2). For the late morning and afternoon sessions, mares exhibited peak feeding rates during wk 1 and 21, which occurred in the spring and fall or late summer. During these time periods, they spent the least amount of time feeding during wk 13. Except for wk 1, both mares and foals exhibited peak feeding periods in the early morning and evening. In a study of Shetland and Welsh pony foals at 7 to 16 wk of age, Schoen et al. (1976) also observed peak feeding periods in the morning and evening.

Foals fed almost entirely when their mothers were feeding, with the increase in the foal's feeding time budget occurring during mare feeding periods. During wk 1, foals spent 9.7 ± 3.8% of the time that the mare was feeding also engaged in feeding. In contrast, they spent only 2.1 ± 1.1 and .6 ± .4% of the time feeding when the mare was active or resting upright, respectively. By wk 21, foals spent 58.5 ± 4.5% of the time that their mother was feeding also feeding, while spending only 9.9 ± 2.5 or 4.7 ± .7% of the time feeding when she was active or resting upright (figure 3).

Among chimpanzees, active food-sharing by the mother with the infant is probably a behavioral strategy that aids in the transition from dependence on suckling to independent foraging (Silk, 1978). Glendinning (1974) found that young orphaned Thoroughbred foals did not develop normal patterns of grazing behavior if they were not turned out with an adult. Among equids, it may be the case that foals learn to divide their total time budget by imitating the adults with which they live, especially their mothers. There may be no cost to the mother, in contrast to chimpanzees that must give their infants food that they have labored to obtain. However, sharing of optimal food resources may be a cost that even horses incur under conditions in the feral and wild state where food resources may be scarce.

During 1980, some of the foals were still unweaned when the weather turned cold and caused an early kill of the majority of the pasture grass. At that time the ponies grass diet was supplemented with grain poured out on the fields. Mares allowed their own foals to eat at a pile of grain that they had obtained access to, but drove other foals off. Similarly, during a preliminary study of Thoroughbred mares and foals that were fed all at once in a paddock, mares shared a grain bucket that they had access to with their own foal, but not with other foals.
In wild and feral situations, optimal feeding times may be influenced by a variety of factors. Included are temperature variation, time of year, migration patterns made necessary by movement between optimal water sources and optimal food sources, and optimal times for other behaviors, which may, in their turn, be influenced by environmental and social factors (Joubert, 1972). Rather than learn optimal feeding times by the inefficient method of trial-and-error, foals may learn from their mothers, who have previously developed their own time budgets according to environmental and social influences. Nevertheless, orphaned foals do learn to graze on their own. Houpt and Hintz (1983) did not find any significant difference in the amount of time orphaned and mothered foals aged 2 to 4 mo spent grazing. Because the orphaned and mothered foals were observed on alternate days, one cannot determine whether they would have been grazing concurrently or whether they were feeding for the same total amount of time but were responding differently to environmental and temporal factors. Clarification of how much the feeding behavior of equids is learned and how

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Figure 2. Effect of time of day on feeding behavior. The mean percentage of time spent feeding by mares (total column) and foals (speckled portion of column) during different times of the day at various weeks of age of the foal. A = 0500 to 0900 h, B = 0900 to 1300 h, C = 1300 to 1700 h, D = 1700 to 2100 h. Values were calculated from the continuous data records for the indicated weeks.
much is innate will require directly comparable observations on orphaned and mothered foals on first exposure to pasture. The clarification is necessary, because the learning of feeding behavior by a foal from its mother may be an important consideration in reducing the stress of weaning.

The primary foods consumed by the ponies were grasses and clovers that grew in open areas of the pastures. However, various other items were occasionally consumed. Several ponies were observed to eat clay. Foals were observed to eat humus on several occasions. Coprophagia occurred in both foals and adults. Many of the ponies were observed to eat leaves, twigs and bark. During one period of the study, a group of ponies regularly entered the woods in their pasture during the evening and browsed for a brief period before resuming grazing activity.

Drinking. Drinking by foals was very rare. Only 21 foal drinking bouts were observed during the entire study. Drinking bouts by foals lasted .06 to .99 min with a mean of .34 ± .06 min (N = 19 bouts that were not censored by the beginning or end of a sample session). The youngest foal observed to drink was 3 wk old. Eight of the 15 foals were never observed to drink before weaning. Nevertheless, foals did usually travel to water sources with their mothers. Once there, they sometimes walked into the water, either with the fore limbs only or with all four limbs. Occasionally they sniffed the water or pawed at it. At times they remained on the bank, sometimes engaging in social interactions with other foals while the mares drank.

Drinking bouts of mares lasted .04 to 1.41 min with a mean of .39 ± .02 min (N = 157 uncensored bouts). The mean length of drinking bouts by mares did not correlate significantly with temperature (r = .04, P > .05), even if the durations of bouts that occurred within 2 min of each other were added together (r = .05, P > .05).

The ponies frequently traveled to a water source together, with all ponies drinking within a brief period of time. Therefore, the frequency of drinking by any individual mare was not independent of the frequency of drinking by other mares. All data were pooled to evaluate frequency, with the total number of drinking bouts being divided by the total number of hours of observation.

At least one drinking bout by the focal mare occurred during 131, or 5.6% of the sessions. Drinking occurred only once in 108 sessions (82%), twice in 16 sessions (12%), three times in six sessions (5%) and four times in two sessions (2%). Times between bouts within a session ranged from .03 to 5.42 min with a mean of .49 ± .17 min (N = 34 between-bout periods).

Frequency of drinking was temperature dependent (figure 4; P = .005). During 8 h of observation at 0 to 5 C, no drinking was observed. During 29.5 h of observation at 5 to 10 C, one drinking bout was observed. Over the temperature range 10 to 30 C, there was a gradual increase in frequency from once every 4.8 h at 10 to 15 C to once every 3.3 h at 25 to 30 C. At 30 to 35 C, there was an abrupt increase in frequency of drinking to once every 1.8 h.

The temperature dependence of drinking frequency was associated with an overall variation in the frequency at various times of the day (Chi-square, P < .01). Drinking was least frequent during the early morning observations when the temperature was still low, comprising only 13.6% of the total mare drinking bouts. During the first part of the early morning (0500 to 0900 h) observation period there was still dew on the grass, which may have contributed to the low frequency of drinking at this time. The distribution of drinking bouts for the late morning (0900 to 1300 h), afternoon (1300 to 1700 h) and evening (1700 to 2100 h) observa-
In the current study, water was not a limited resource. In the pastures in which the ponies were kept, there was either a pond, a stream running the length of the pasture, or both. Grass grew right up to the edge of the streams and ponds. Also, the grass had heavy dew cover in the morning and the water content of the grass was possibly higher than in the arid areas where feral horses have been studied.

Aggression at water sources was very rare and mild. Rearing, kicking and chasing, such as were observed by Berger (1977) and Miller and Denniston (1979), were never observed. Neither did the ponies congregate at the water sources for long periods of time.

Blakeslee (1974) observed drinking in Appaloosa foals in Idaho during their first week of life. At that age the foals had difficulty drinking and had to spread the fore limbs apart to do so. The Welsh pony foals were never observed to attempt to drink at such a young age. Because the Appaloosa mares did not have water sources as plentiful and easily accessible as the Welsh pony mares did, they may not have been producing as much milk, thereby causing their foals to become thirsty earlier than the Welsh foals. Drinking was so rare in the Welsh pony foals that it is probable that they obtained sufficient water via their mother's milk and the grass available to them.

In the 19th century, management of domestic horses was such that they frequently suffered from water deprivation. Particularly in warm weather, the horses may have been chronically thirsty. This would account for a tendency to drink excessively when they finally obtained access to water. Fortunately, offering water ad libitum has become the rule during this century (Hinton, 1978). The current study, in which the frequency of drinking by lactating mares given free access to water was quantified, indicates that ad libitum access allows horses to drink frequently and in a spontaneous pattern. A direct correlation of drinking frequency with ambient temperature was demonstrated, with a large increase in frequency occurring at temperatures greater than 30°C. These values should be taken into consideration when a lactating mare is being maintained under conditions in which she does not have free access to water, especially during hot weather. It may be that frequency of drinking by foals can be used as an indicator of the adequacy of the dam's milk supply to meet the fluid as well as the energy requirements of the foal.
Literature Cited


