The Effect of Artificial Rearing on the Growth of Foals

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THE EFFECT OF ARTIFICIAL REARING ON THE GROWTH OF FOALS[1,2,3,4]

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Summary

Fourteen Quarter Horse foals were used to evaluate the effects of artificial rearing on growth. Seven foals were removed from their dams at 3 d of age and fed a reconstituted 26% crude protein (CP) milk replacer free choice for 1 mo, at which time ad libitum solid feeding began. Controls were weaned from their dams at 2 mo of age and fed a 21% CP concentrate ad libitum until the end of the trial. Variables measured during the 26-wk trial were live body weight, height at the withers and length of body from point of shoulder to point of hip. No significant differences were found between the two groups, except during wk 8 where 2-mo weaned foals were slightly heavier ($P<.10$). Average daily gains for artificially reared and 2-mo weaned foals were .95 and .98 kg, respectively.

(Key Words: Artificial Rearing, Early Weaning, Equine, Growth, Foals.)

Introduction

The ability to raise livestock using artificial rearing systems has been well documented in lambs (Hinds, 1960; Wardrop, 1960; Owen and Davies, 1965, 1968; Orskov et al., 1971), calves Aitken, 1963; Harshbarger and Nosker, 1964) and pigs (Leibbrandt et al., 1975; Lecce and Coalson, 1976; Lecce et al., 1979). Little data exist concerning the early weaning of foals. While many orphaned foals have been raised successfully, there has been much concern expressed by horsemen as to whether the orphaned or early-weaned foal can reach the same size at maturity as the foal reared by its dam.

The main objective of this experiment was to study the effect of artificial rearing on the growth of foals from birth to 6 mo of age. Foals weaned abruptly at 2 mo served as controls. A second objective was to test the feasibility of providing milk replacer ad libitum in order to reduce the heavy labor demands that are generally required with current artificial rearing systems.

Materials and Methods

Fourteen Quarter Horse foals were alternately assigned at birth to one of two treatment groups in order to minimize seasonal effects. The two treatment groups were: A) removal from the mare at 3 d of age and artificially reared and B) weaned from the mare at 2 mo of age. There were five colts and two fillies in treatment A and five fillies and two colts in treatment B.

Foals placed on an artificial rearing system were removed from their dams 3 d postpartum and isolated for approximately 4 h. Previous research at this station (unpublished) established that a 4-h isolation period enhanced the acceptance of liquid diets by foals. The milk replacer (table 1) was mixed at a 5:1 ratio with water at 32 C in a plastic bucket. The foals were encouraged to nurse by directing their heads toward the bucket. Once the foals drank the replacer, the bucket was placed on a hook approximately 76 cm from the floor. The foals were individually fed freshly mixed replacer at

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TABLE 1. PERCENTAGE COMPOSITION OF MILK REPLACER[a,b]

Item	%
Soy flour (IFN 5-04-592)	26.0
Sweet whey (IFN 4-01-182)	42.75
Animal fat (IFN 4-00-376)	20.0
Casein (IFN 5-01-162)	10.0
Calcium carbonate (IFN 6-01-069)	.625
Premix[c]	.625

[a]Dry matter basis.

[b]Contains 26% crude protein, 20% ether extract and .75% fiber.

[c]Vitamins and minerals supplied to exceed requirements by 20%. Contains 50 g chlortetracycline/ton of finished product.

0800 and 1600 h. Milk not consumed was measured and discarded. Buckets were scrubbed daily. All milk replacer, with the exception of the first meal, was mixed and provided at room temperature. The foals were also offered .23 kg of a milk-based pellet[6] free choice at 3 d of age. As the foals' appetite increased, the amount fed increased until a maximum level of 1.36 $kg \cdot foal^{-1} \cdot d^{-1}$ was reached. At this point, .23 kg of the concentrate feed (table 2) was added and increased by .23-kg increments as the demand increased. Foals were turned out for 1 to 2 h each day to exercise. At 1 mo of age, the foals were moved to a 3.6 × 5.5 m foaling stall with an adjoining paddock in which to exercise at will. The milk replacer was eliminated from the diet and the milk pellet-concentrate mixture was continued ad libitum to 2 mo of age. At this time, foals were moved to a large drylot with access to an adjoining loafing shed and pasture and received only the corn-soybean meal (SBM) concentrate ad libitum until 6 mo of age. Foals in the control group were weaned abruptly from their mares at 2 mo of age and placed in the drylot with the other foals. Water, trace mineralized salt, limestone and dicalcium phosphate[7] were offered on a free-choice basis throughout the study. All leftover feed was measured and recorded throughout the 6-mo trial. Feed consumption data are expressed on a dry matter basis unless otherwise noted.

Individual feed intakes, both liquid and solid, were recorded for the artificially reared foals during the first 2 mo of the trial. Due to the design of the equine facility, it was impossible to stall and feed the foals individually during the final 4 mo of the trial. Therefore, daily feed intakes are reported as pen averages.

Live body weight, wither height and body length from point of shoulder to point of hip were measured on a weekly basis from birth until 6 mo of age. Measurements were taken 3 to 4 h after the morning feeding.

Data were analyzed as a completely randomized design using the one-way analysis of variance (Steel and Torrie, 1960).

Results and Discussion

Growth data for the 26-wk trial are presented in tables 3 and 4. Artificial rearing did not significantly affect the growth of foals to 6 mo of age. Foals that were artificially reared weighed less ($P<.10$) than foals in the control group at 8 wk, but this difference was no longer evident by 10 wk of age.

Average daily gains of the artificially reared foals decreased gradually during the first 3 mo and were significantly lower than the controls at 2 mo of age. Foals in the control group experienced a decrease in daily gain during the third month, which may have been attributable to postweaning stress. Most of this weight loss

TABLE 2. PERCENTAGE COMPOSITION OF CONCENTRATE[a,b]

Item	%
Ground corn (IFN 4-02-931)	60.4
Soybean meal, 44% (IFN 5-04-604)	33.0
Cane molasses (IFN 4-02-696)	3.0
Limestone (IFN 6-02632)	1.0
Dicalcium phosphate (IFN 6-01-080)	1.0
Brewers yeast (IFN 7-05-528)	.5
Trace mineralized salt[c]	1.0
Vitamins A and D[d]	.1

[a]Diet calculated to contain 21% crude protein, .5% Ca and .4% P.

[b]As-fed basis (97.3% DM).

[c]Supplied per kilogram of feed: 35 mg Zn, 28 mg Mn, 17.5 mg Fe, 3.5 mg Cu, .7 mg I, .7 mg Co.

[d]Supplied per kilogram of feed: 30,000 IU vitamin A, 33 IU vitamin D^3.

[6] Start-to-Finish, Milk Specialties Co., Box 278, Dundee, IL 60118.

[7] Dynafos, International Minerals and Chemicals Corp., Mundelein, IL 60060.

TABLE 3. GROWTH OF QUARTER HORSE FOALS ARTIFICIALLY REARED (A) AS COMPARED WITH CONTROLS (B)[a,b]

Week	Treatment	Measurement		
		Body weight, kg	Wither height, cm	Body length, cm
1	A	59.4 ± 10.9	96.5 ± 3.6	52.2 ± 4.5
	B	60.0 ± 2.4	95.2 ± 1.1	53.9 ± 2.4
4	A	81.8 ± 10.1	101.1 ± 3.1	59.8 ± 1.9
	B	86.1 ± 6.3	101.6 ± .6	61.1 ± .8
8	A	109.4 ± 9.1†	108.4 ± 3.3	68.2 ± 3.5
	B	121.1 ± 7.2	108.4 ± 1.5	69.8 ± 2.5
12	A	135.6 ± 8.2	111.7 ± 2.9	74.0 ± 2.7
	B	138.6 ± 7.2	111.5 ± .8	73.4 ± 1.6
16	A	156.1 ± 12.8	116.0 ± 2.8	78.4 ± 3.1
	B	169.5 ± 6.5	116.0 ± 1.3	78.4 ± 1.7
20	A	183.5 ± 16.4	119.8 ± 2.8	82.9 ± 1.9
	B	200.5 ± 6.5	119.8 ± 1.1	82.2 ± 1.3
24	A	210.9 ± 16.9	123.6 ± 2.6	86.7 ± 2.5
	B	229.4 ± 15.7	124.7 ± 1.7	86.5 ± 1.8
26	A	227.9 ± 20.0	125.4 ± 3.1	89.2 ± 2.9
	B	237.1 ± 17.2	125.9 ± 2.1	89.0 ± 2.3

[a]Treatment mean ± SE.

[b]Seven bservations/treatment.

†P<.10.

occurred during the first week after weaning, with daily gains of −.41 ± 1.2 kg/foal. By the second week postweaning, average daily gains were comparable with those of the artificially reared foals and both groups continued to gan similarly during the remaining 14 wk of the trial.

Artificially reared foals consumed 1.09 ± .2 kg of milk replacer and 1.21 ± .24 kg of solid feed/d during the first month and 2.24 ± .17 kg of concentrate/d during the second month. Average daily feed intake for all foals during the final 4 mo of the trial were 3.0, 3.6, 3.7 and 3.71 kg, respectively.

No difficulties were encountered when foals were provided milk replacer free choice. Foals appeared to consume small quantities of milk frequently. Excessive gorging was not observed. None of the artificially reared foals developed diarrhea to any degree, although the fecal material was rather soft during the liquid feeding phase. No other digestive disturbances were noted under this system.

While overall performance of the foals indicated that artificial rearing had no deleterious effect on growth, decreased gains were recorded for foals in this group during the first 3 mo. It appears likely that the decrease in gain observed during the first month, as compared with controls, was probably due to the relative immaturity of the foal's digestive system with

TABLE 4. AVERAGE DAILY GAINS (KG) OF ARTIFICIALLY REARED FOALS (A) WHEN COMPARED WITH CONTROLS (B)[a,b]

Month	Group	
	A	B
1	1.15 ± .29	1.26 ± .12
2	1.00 ± .11	1.22 ± .18*
3	.91 ± .18	.67 ± .27†
4	1.02 ± .23	1.11 ± .15
5	.88 ± .30	.98 ± .31
6	.88 ± .17	.99 ± .27
Overall	.95 ± .15	.98 ± .1

[a]Treatment mean ± standard error.

[b]Seven observations/treatment.

†P<.10.

*P<.05.

respect to its ability to utilize vegetable-based feeds. The milk replacer used in this study contained 26% soy flour, and the lower gains obtained at this time are in agreement with data collected from dairy calves fed vegetable-based milk replacers (Wallace et al., 1951; Noller et al., 1956a,b). In the latter studies, calves fed milk replacers that contained 20 to 40% soy flour during the first month after birth gained less weight than did calves fed milk. Results of digestibility studies indicated that calves could not effectively utilize soy-based milk substitutes until the calves were about 25 d of age (Noller et al., 1956b). From 1 mo of age, all calves gained similarly with no difference at 4 to 6 mo of age (Wallace et al., 1951).

A reduction in performance due to insufficient enzyme activity was also suggested by Shields et al. (1980), who reported decreased gains in pigs for approximatey 2 wk after weaning onto corn-soybean meal diets at 2 wk of age. By 6 wk of age, pigs weaned at 2 and 4 wk had similar body weights. The increase in live weight gain by the 2-wk weaned pigs appeared to coincide with increased pancreatic amylase activities. This may also explain the reduction in gain that occurred in both groups of foals during the third month. As the proportion of corn-SBM concentrate increased in the diet of these foals, feed intake also increased but daily gains decreased. This suggests that foals at this age lacked the ability to digest large quantities of grain in their diet, but showed the capability to adapt to the dietary change as evidenced by the improvement in gain. By 4 mo of age, the average daily gains were similar for both groups and remained so throughout the trial. It is likely that decreased feed intake, reduced enzyme activity and weaning stress contributed to the large decrease in gain observed in the controls after weaning, but the relative contribution by each could not be determined. Although live body weight was affected, there appeared to be no impairment of bone growth, as indicated by wither height, during any phase of the experiment. There was no evidence of any skeletal abnormalities until the last 5 wk of the trial when three foals in the control group developed epiphysitis. These foals were very straight at the pastern and well-muscled but appeared to be fat over the withers and rump. This may have been genetically influenced as these foals were paternal half-siblings. Once removed from the trial, all signs of epiphysitis had disappeared within 5 wk.

Ad libitum feeding of milk substitutes to foals has been discouraged because it has been thought to lead to excessive milk intake, predisposing the foal to noninfectious diarrhea. Foals receiving milk replacer ad libitum consumed 11.7 ± .281 (12.1 kg)/d. This is in close agreement with consumption data of nursing foals by Gibbs et al. (982) and is approximately three times greater than the amount of replacer suggested for daily feeding of orphan foals in equine husbandry texts. There was no evidence of scours in any of these foals, while several of the control foals had diarrhea when their dams were in foal-estrus. From the milk consumption data presented here, it appears likely that the poor growth response usually seen with foals reared artificially may be due to insufficient quantities of milk being offered to the foal during the period of rapid growth.

No ethological studies were done concurrently with this experiment, but no aberrant behaviors were noted and none have been reported thus far. Animals that were artificially reared were much more tractable at an earlier age due to increased human contact.

Results of this research indicate that artificial rearing systems are applicable to the equine with no measurable adverse effects on the growth of the foal. This method provides a viable alternative for the orphan foal or when early separation of the mare and foal is indicated. As with most livestock production systems, management plays a key role in obtaining maximum animal performance. It should be pointed out that artificial rearing of the foal may be of limited use because of the high cost of labor and milk-based substitute feeds. This system could become more practical and economical if these milk products could be replaced with other less expensive feedstuffs, i.e., cereal grains, without causing any adverse effects on the growth of the young animal. For this reason, more research is needed that studies the growing foal's adaptive capabilities and physiological changes so that adequate nutrition and optimum growth can be assured.

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