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Artificially suckled I.H.D.H. (Italian Heavy Draught Horse) foals: *in vivo* performances and ethograms

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ABSTRACT - The research was carried out on 6 "Italian Heavy Draught Horse" orphan foals artificially suckled by an automatic milk feeder. The purpose of the research was to show that artificial weaning does not have a negative effect on a foal's growth and welfare. The foals were reared in an indoor box, weighed every 3 weeks from day 4 after birth and observed for 24 consecutive hours at the age of 4, 10, 47, 114, 142 and 176 days, to compile an ethogram which includes biorhythms, and social, alimentary and eliminative behavioural patterns. During the study, "daily weight gains" were greater than 1610 g/d; but between 26 and 46 days and after weaning, values were lower than 1230 g/d, and between 172 and 193 days, prior to slaughtering, they were of 1090 g/d. Age had a significant influence ($P<0.001$) on almost all the ethological parameters considered, above all for the time spent lying down and the licking structures ($P<0.01$), and for the drinking bouts ($P<0.05$). The period of adaptation to artificial feeding certainly lasted at least two weeks. These results suggest that the technique of artificial suckling can be applied to horses without negative effects on growth and welfare, any subjects showed abnormal behaviour.

Key words: Animal welfare, Artificial feeding, Ethogram, Foal.

Introduction - The ethogram, breeding techniques and early weaning of foals have been the subject of many studies (Carson and Wood-Gush, 1983; Davies Morel, 2000). The practice of rearing foals in the absence of their mares is considered to be very delicate, because without maternal imprinting the welfare of the animal might be compromised, with the consequent development of behavioural disturbances (Mills, 2001). Houpt *et al.* (1982) have demonstrated that the loss of the mother does not completely compromise the learning capacity of foals. While, on one hand, this may not be a serious problem for the breeds destined for meat production, as is the case of I.H.D.H., the loss could nevertheless have a negative influence on the growth rates of these animals, which otherwise tend be very high above all in the first two months of life, with a daily increase of 1800 g (Centoducati and Tateo, 2003). The purpose of this study was to observe artificially suckled I.H.D.H. foals in order to evaluate their behaviour, and the influence of this new technique on breed performance.

Material and methods - Six I.H.D.H. foals were used for the trial, 4 males and 2 female born within three days of each other and orphaned just after foaling. The weight of the experimental group was homogeneous (46.5±1.3 kg). They were reared at the Faculty of Veterinary Medicine Hospital of Bari in an 8x4 m indoor stall. The stall was equipped with an artificial feeder for calves, adapted to administer milk replacer. After 4-6 hours without feeding, the foals were offered a bottle with milk and were encouraged towards the feeding station. The milk powder used was a milk replacer for calves (60 gr of milk powder per litre of water at 40°C) that was

Table 1. Ethogram taken over 24h at the different ages (M±SE).

	AGE (days)	4	10	47	114	142	176	S.E.	P
Biorhythms	Lying duration (min/d)	810.7^{A}	841.3^{Aa}	624.3	572.7^{b}	534.2^{B}	560.5	61.57	**
	Lying frequency (n/d)	24.3A^{Ca}	33.0^{Ab}	16.2^{BCc}	9.0^{Bd}	9.5^{Bd}	10.5^{B}	2.03	***
	Mean duration of every lying bout (min)	33.6^{A}	25.7^{Aa}	38.3^{Ab}	64.4^{Bc}	56.1^{B}	53.4^{Bd}	2.96	***
	Sternocostal Lying %	42.9A^{ad}	60.1^{bc}	53.9^{bd}	62.2^{b}	72.8^{Bc}	71.1^{Bc}	4.66	***
	Lateral Lying %	57.1^{Aa}	39.8^{bc}	46.0^{ac}	37.7^{bc}	27.2^{Bb}	28.8^{Bb}	4.66	***
	Standing Duration (min/d)	530.6^{B}	187.0^{A}	580.2^{Ba}	495.0^{B}	482.5^{B}	426.5^{Bb}	40.06	***
	Standing frequency (n/d)	58.0^{B}	77^{a}	103.3^{Ab}	96.3^{A}	52.8^{B}	45.5^{Bc}	8.04	***
	Average standing (min)	9.1^{A}	2.4^{B}	5.6^{C}	5,2^{C}	9.1^{A}	9.5^{A}	0.61	***
	Defecation (n/d)	7.7	7.3	6.5	7.3	5.3	7.0	1.92	n.s.
	Urination (n/d)	17.3	13.7^{a}	13.0^{A}	24.0^{Bb}	14.0^{a}	13.2^{a}	2.19	n.s
Alimentary behaviour	Drinking (n/d)	1.0^{a}	0.0^{a}	9.8	13.6^{b}	12.2^{b}	9.5	3.31	*
	Sucking duration (min/d)	44.3^{A}	255.0^{B}	78.0^{A}	.	.	.	18.30	***
	Sucking frequency (n/d)	31.7^{A}	88.0^{B}	34.7^{A}	.	.	.	4.30	***
	Average sucking bout (min)	1.4^{a}	2.9^{b}	2.2	.	.	.	0.24	*
	Concentrate feeding duration (min/d)	0.0^{A}	7.0^{A}	28.3^{A}	145.3^{B}	149.3^{B}	129.5^{B}	11.91	***
	Concentrate feeding frequency (n/d)	0.0^{A}	3.7^{A}	12.2^{AC}	35.7^{CD}	22.0^{Bb}	14.7^{BCa}	1.60	***
	Accesses to concentrate average (min)	0.0^{Aa}	1.9^{ABb}	2.3^{Bb}	4.1^{Bc}	6.9^{C}	8.5^{C}	0.51	***
	Hay feeding duration (min/d)	0.0^{A}	10.0^{A}	27.5^{ACa}	89.3^{Cb}	190.8^{Bc}	252.0^{Bd}	17.43	***
	Hay feeding frequency (n/d)	0.0^{A}	5.0^{A}	10.8^{a}	26.3^{Bb}	23.5^{Bb}	28.0^{Bb}	3.70	***
	Average Access to hay (min)	0.0^{Aa}	1.9^{ABb}	2.6^{B}	3.1^{B}	8.2^{C}	9.0^{C}	0.58	***
Social behaviour	Interactions (min/d)	10.0^{b}	56.0^{a}	9.8^{b}	26.7	17.5^{b}	25.2	10.54	n.s.
	Play (min/d)	0.7^{b}	16.7	22.7^{a}	8.0	2.7^{b}	1.0^{b}	5.99	n.s.
	Aggressive Events (n/d)	0.0^{A}	12^{B}	0.3^{A}	0.3^{A}	0.2^{A}	0.5^{A}	1.25	***
	Cross- sucking (n/d)	0.0^{A}	26.7^{B}	2.3^{A}	3.0^{A}	0.8^{A}	1.0^{A}	2.0	***
	Licking structures (n/d)	0.3^{Aa}	23.7^{Bcd}	12.5^{bd}	18.7^{BCbc}	4.7^{ACa}	11.5^{b}	3.21	**

On the same line the values differ by P<0.01 (A, B, C) or P<0.05 (a, b, c, d).
*Variance analysis: * (P<0.05), ** (P<0.01), *** (P<0.001), n.s. (Not significant).*

integrated with 3% calcium carbonate (Martin-Rosset, 1990). The foals were fed *ad libitum*. A treatment with probiotics was carried out (twice a day for five days). After the first day of the trial, the foals were provided with a fattening food and a good hay. Between the ages of 114 and 120 days the foals were gradually weaned. Subsequent to weaning, the concentrate was subdivided and thus rationed in three daily administrations. The quantity given was calculated according to the requirements indicated by Martin-Rosset (1990). The test animals were slaughtered at 6 months, when they reached a live weight of around 350 kg. The ethogram was compiled, in the stall, by means of direct observation for a total of 24 consecutive hours from day 4 after birth and at the age of 10, 47, 114, 142 and 176 days. The foals were weighed every three weeks on a platform scale up to the age of 6 months. From this data, the daily weight gains of the individual animals were calculated. All

ethological data were submitted to the application of a general linear model using the SAS GLM procedure (1997), indicating as independent variable the age at which the controls were made, according to the following formula: $y_{ij}=\mu+AGE_i+\varepsilon_{ij}$ where: y_{ij}: ethological parameters ; μ: general mean; AGE_i: fixed effect of the i^{th} AGE (i=1,…,6); ε_{ij}: S.E.. For differences between the least square means Student's t-test was used as post hoc test.

Results and conclusions - During the study "daily weight gains" were greater than 1610 g/d, exceeding that of I.H.D.H foals reared naturally (Centoducati and Tateo, 2003); but between 26 and 46 days and after weaning, values were lower than 1230 g/d and between 172 and 193 days, prior to slaughtering, they were of 1090 g/d. The maximum daily weight gain of 2140 g/d was registered in the first period, as in the case of naturally reared I.H.D.H. foals (Centoducati and Tateo, 2003). All the ethological parameters are shown in the table 1. The frequency of daily suckling observed at the age of 10 days is comparable with that reported by Carson and Wood-Gush (1983), but not with the control at 4 days. The reason for this difference could be that at 4 days there is in progress a process of adaptation to artificial feeding, to socialization with other foals, to detachment from the brood mare and to the new environment in which the foal is reared. The period of adaptation has effects on all the other behavioural patterns observed. In particular, it involves the alternation of standing and lying down as well as the type of lying down. In our study, at 4 days the foals spent a great deal of time standing and this subtracted much time from lateral lying. The hypothesis that adaptation had not yet been attained in this phase, is confirmed by the progressive increase during the initial period (up to 47 days) in the frequency of standing bouts, which then decreased in the subsequent period ($P<0.01$). Taking these parameters into account, we can state that the period of adaptation to artificial feeding certainly lasted at least two weeks, therefore in agreement with what is reported in the bibliography and according to the parameters linked to animal welfare (Amadori *et al.*, 1997). At the age of 47 days the foals fed in a more regular way and their interest in the concentrate and hay was significantly greater than at the previous controls. Solitary play was observed for a longer time, 47 days, also with respect to what is reported in literature, while interactions with other foals began earlier than occurs in nature (Tyler, 1972), probably because play with the mother was substituted at an early stage by that with other foals. Abnormal oral behaviours such as cross-sucking and aggressive events were concentrated only at 10 days, whereas they disappeared after 47 days. This confirms that after an acute stress, physiologically the adaptation process lasts two weeks. Aggressive events were almost always either for defence or as a result of competition for the teat or for the attempts of foals to feed from the stifles or umbilici of the other foals. The behaviour of artificially suckled foals does not seem to be negatively influenced either by the absence of the brood-mare or by the rearing technique utilized. Artificial suckling could therefore be practiced to breed orphan foals, or, in the future, with a view using the equine milk in cosmetics (Balestra, 1995) and in paediatrics (Businco *et al.,* 2000). Further studies are necessary, and are being carried out, to define the meat quality of these foals.

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