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Influence of management and nutrition on growth in young thoroughbred horses: a case study on

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Summary

In race horses both training and racing start when growth and bone development are not completed: this situation affects considerably osteoarticular pathologies, generally depending on nutrition imbalances and mistakes in feeding planning. Management and feeding practices should be adjusted to support a high body development and to prevent the appearance of Developmental Orthopaedic Disease(DOD). An experimental controlled and balanced nutrition planning was carried out in young thoroughbred horses from weaning till 18 month(sales period) over a 12 years period. At the beginning of this experiment many negative aspects concerning management and nutrition were observed and they involved a high percentage of developmental diseases, scarce growth and poor performances in races. The changes carried out progressively in the stud concerned the use of specialised technicians in horse nutrition, monthly checks of horses for general welfare conditions, live weight, clinical conditions, parasites controls feet conditions, ration formulation in relation to monthly controls and improve in breeding planning. The success of this experiment permitted to balance the ration in relation to growth and to improve considerably the quality of these horses as demonstrated by the evident decrease in DOD and by the increase of sales and breeder's prices during these years.

Key words: growing horses, management, feeding practices, grazing

Introduction

Young race horses are expected to become top quality race and performances athletes; these horses begin training and racing at 15 months and 24 months respectively when growth and bone development are not compeleted. The consequence of this situation is that management, nutrition planning and feeding practices should be adjusted to support a high body development as permitted by their genetic potential. In fact, growth and bone characteristics are strictly linked to the evolution of the live weight and are influenced by age, exercise and, consequently, by the corresponding feeding strategies. Foals of race breeds weight between 220 kg bw. at weaning and 420-450 kg bw. at 18 months (INRA, 1990; Martin-Rosset, 1983; Martin-Rosset, 2004; Pagan, 1998; Paragon *et al.,* 2000 Willoughby, 1975). Foals could growth till 1600 g/day in the first month with an average value of 750 g/day till 6 months: horses reach, at 6 months, 50p100 of the adult weight. At 12 and 18 months of age race horses reach respectively 66p100 and 80p100 of the final weight. Bone development reaches 80% of the total development at 18 months. If we consider that the birth weight is 10p100 of the adult weight, it is easily comprehensible the onset of growth pathologies if the nutrition planning and the managements and care practices are lacking. Horses are expected to grow at a faster rate now(Jackson, 1998): in feeding practices this means that yearling race horses are fed high feeding plans as early as they are still suckling the mare; as a result foals and yearlings are offered high feeding level, from 15 to 20 % over the requirements designed by INRA(INRA, 1984 - 1990); generally the ration of these horses is constituted by high quality forages(green forages OMD = 60-70%; hays OMD = 55-60%), supplemented with high percentages of

concentrates: 40 to 60% in DM, depending on the forage quality, on the age and on the physical activity of yearlings. The osteoarticular pathologies generally depend on nutrition imbalances and mistakes in feeding planning. The etiology of Developmental Orthopaedic Disease (DOD) is of multifactorial origins(Mc Ilwraight, 2001), but nutrition plays the most important role in its development(Duren, 1998; Ellis, 2004; Harris *et al.,* 2004; Valette *et al.,* 2004); inadequate levels of proteins, minerals and energy could influence skeletal misdevelopment in young horses(Ellis & Lawrence, 1978; Gibbs *et al.,* 1987; McCarthy, 1990; Potter, 1982; Savage *et al.,* 1993, Wolter, 1990). Nevertheless, while the researches carried out in the last 15 tears evidenced the importance of balanced rations in growing diets, most part of the horsemen continue to feed traditional rations generally composed by oats and hay and pasture only(Jones, 1989). Many nutrition-related disorders are usually a consequence of mis-management systems, which work against rather than with nature, such as high carbohydrate, low fibre diet, sudden changes in feeding, etc., as pointed out by some authors attending the 2nd European Workshop on Equine Nutrition held in Dijon on January 2004(Austbo, Bergero, Coenen, Ellis, Harris, Jeffcott, Martin-Rosset, Miraglia, Valette). But other aspects, together with the nutritional ones can expose horses, directly or indirectly, to growing problems: selection, care and management(Hoppe & Philipsson, 1985; Miraglia *et al.,* 2000; Miraglia, 2004). Every stressful condition that alter the theoretical growth curve affect negatively the complete development of the horses and the expression of the genetic potential. In the last 20-30 years the development of skeletal problems in young horses is more and more obvious and this situation could come both from hypo or hyper nutrition that often origin the development of orthopaedic diseases(DOD) that include osteochondrosis, physitis or epiphysitis, flexural deformities(contracted tendons), etc.(Jeffcott, 2004; Kronfeld, 1990). Overfeeding is frequently blamed in development of these kind of diseases, mainly in foals that are growing rapidly. The negative effects of overfeeding is amplified if feeds used in the diet are characterized by minerals imbalances, lacks in essential amino acids, excess of carbohydrates etc.(Ellis, 2004; Harris, 2004). In this context it was carried out the monitoring of a thoroughbred stud farm over 13 years preceeded by previous observations in the two years before(Miraglia *et al.,* 1996). The breeder accepted to introduce progressively all proposals concerning the changes in management and nutrition planning giving us the possibility to modulate and adaptate the scientific principles to practical field conditions. The results lead to a join between theory and practice that agree, on one hand, to maximize the selection efficacy and, on the other, to improve the economical advantages. 13 generations(foals born from 1990 to 2002) of the thoroughbred horses bred in this stud(370 heads at all, on the average) were observed from weaning to 16-18 months(sales period) in order to verify the influence of management and nutrition changes on growth and on performances. In 1995 the breeder aquired a stud farm in Ireland of 80 ha where he transferred the 80% of the mares. After weaning the foals arrive in Italy and follow the management planning. Most part of the foals are sold by sales starting from September. The income of the stud is represented by the sales prices and by the breeders prices.

Material and methods

The thoroughbred stud farm(Pian del Lago Stud Farm) is located near Siena(Tuscany) and is characterized by a total surface of 55ha with 15 paddocks of surface ranging between 2 to 5 ha and a stocking rate of 1,5 heads/ha at the beginning of the monitoring. Paddocks are characterized by clay soils and the kind of forage grazed is a natural meadow with prevalence of grasses. The hay is produced in the farm. The chemical composition of the green forage is constant enough and it is characterized by 7-8% of crude protein, 32-34 % of crude fiber and 0,45-0,50 HFU/kg on DM basis; nevertheless, the production of a certain amount of green forage is limited to 2-3 months only, during the spring season. 13 years ago, at the beginning of these experiment, many negative aspects concerning management and nutrition were observed. In particular, there was not a schedule planning in all the management practices of the stud farm: nutrition was only a marginal aspect

and the high percentage of bone diseases were considered almost a normal phenomenon and the veterinary came in the stud only when pathologies were evident. The changes that were progressively carried out in the stud were the following:

- use of specialised horse technicians(grooming, nutritionists, veterinarians) to control the feeding planning and the animal welfare
- monthly checks of horses for:
  *live weight
  *clinical conditions including, if necessary, radiographic controls in correspondence of the critical development period(6-12-15 months of age)
  *parasites controls
  *feet conditions
- ration formulation in relation to monthly controls, sometimes head/head: in fact, in the case of excessive or low live weight and increase of bone diseases, horses were kept out by the herd to allow an individual ration with adequate dietetic feeds and supplement useful for the specific problem
- forages employed: at the beginning of the monitoring the hay administered to the horses came in large part from the grazed surface(1^{st} cut); the consequence was the considerable incidence of parasites, tenia in particular way, with many consequent colic phoenomena. After these problems, the hay administered to the horses did not came more from the grazed surfaces
- use of appropriate care systems in pasture management(rotations, fertlization, safeguard from parasites diffusion in the sward, etc..)
- constitution of small groups of foals in relation to aggression phoenomenon(hierarchy establishment), to age, to sex, to growth disorders, to stereotypic behaviours(e.g. cribbing)
- time spent outdoor: 24 hours/day; particular feeders for the administration of concentrates and supplement were introduced in the padock. Horses were put indoor once a month for the routine controls
- stocking rate: the number of heads/group was prograssively reducted and the stocking rate decreased from 1,5 to 0,7 heads/ha
- improving in breeding planning: selected mares and stallions were progressively introduced by the breeder.

Results and discussion

Feeding planning and feeding technologies

During these 13 years the feeding planning was progressively modified in 3 different steps. It is important to underline that at the beginning of the monitoring(previous observations, Miraglia *et al.,* 1996 – years 1988-1989), the horses received natural meadow hay and oats only without supplements. The amounts of oats was uncontrolled and the incidence of DOD was of 80% at weaning and at 18 months. After a transitional phase concerning horses born in 1990 and 1991 in which a blended grain mix (flaked barley, rolled corn, oats, bran) together with soybean meal and supplements(aminoacidic-vitamins-minerals supplements) was administered to the horses, from the following years after a progressively change in the concentrate characteristics was introduced. In 1992 till 1995 it was used a specific mixed feed for young horses together with supplements(minerals and aminoacids). Starting from 1996 the introduction of particular dietetic feeds administrated together with flaked barley and specific supplements completed the success in the management pracitces of the stud farm. Tables 1 and 2 show respectively the different composition of foods and the rations progressively used at the stud farm the different years from 1990 to 2002. Table 2 shows that in the case of foals born between 1990 and 1994 it was respected

a nutrition plan with values of DCP near to the INRA requirements(INRA, 1990) because the most important aim of that period was to reduce DOD; in the following years(foals born between 1995 and 2002) the amount of DCP was over the INRA requirements, 4 to 16% respectively for weaned and yearling horses.

Live body weight, growth rates, incidence of development disorders and performances

Figures 1 and 2 show the trend of the body live weight from weaning till 18 months and the comparison with the theoretical values(INRA, 1984) for horses born from 1990 to 1994 and from 1995 to 2002. In the first case(horses born from 1990 to 1994) the observed values are under the theoretical ones while, in the second case(horses born from 1995 to 2002), almost all the generations show values near or over the theoretical ones. Figures 3 and 4 show the growth rate of foals in relation to month of birth, respectively for horses born between 1990 and 1994 and for horses born between 1995 and 2002. Figures 5 and 6 show the growth rate of foals in relation to season referring to the same 2 class of generations(1990 to 1994 and 1995 to 2002). A critical period of growth occurred when horses were 10-12 months old, a period that corresponds to winter time when the green forage availability is scarce. In fact in all the cases it was observed a reduction of the daily gain in the months between January and March corresponding, on the average, to the age of 10 – 12 months of age and a following increase of the daily gain in the months after. These results are in agreement with those obtained by Pagan(1998) in Kentucky thoroughbred farms. This means that in all the 13 generations, there was a trend to develop a compensatory growth from spring time on. This aspect is particularly evident in the foals born on January, February and March, while in the case of foals born in April and May were observed alternated and variable values of daily gain, mainly evident in the case of the foals born in the years 1990-1994(Figures 3 and 5). The problem linked to this compensatory growth could be the development of growth disorders. The progressive changes carried out both in management and feeding planning permitted to reach at 16-18 months of age the standard values of weight with a progressive reduction of DOD from 1990 to 2002(table 3). At the same time there was a considerable reduction of underweighted foals at weaning and at 16-18 months. The performances in race increased progressively from 1990 on: in fact, the percentage of horses never in races decreased from 23 to 10%, the horses never placed decreased from 31 20%(this values is influenced also by the trainer quality) and the horses winnings and/or placed increased from 46 to 70% with a peak for horses born in 1997 for which this values was of 93%. Nevertheless, even if the percentage of horses winning and or placed increased almost immediately after the changes in management and nutrition planning, there was a considerable difference in the level of races and, consequently, on the breeders prices that increased of 350% in the same period. Another consequence of this situation was the increase of sales prices that increased of 300% as a result of the high level performances obtained by the horses bred in this stud farm.

Conclusions

In young horses destined to competitions it is important to underline the very early bone development during the first year that is strictly linked to the evolution of body live weight, to the age and to the exercise and, consequently, to the corresponding feeding strategies that determine the incidence of development diseases and performances. In this context an important role is played by the management practices in the most relevant growth critical periods, namely when foals are aged 6 and 12 months(Polidori *et al.,* 2000; Warren *et al.,* 1998) . The use of special technologies, such as creep feeding in the pre-weaning phase, dietetic feeds, appropriates supplements, etc., a correct exploitation of the pastures (kind of pasture, stocking rate, parasites controls, pasture care, etc.) and, finally, a continuous healthy monitoring of horses from specialised veterinarians will determine the difference in develop a champion or just another horse(Miraglia, 2004). In the case

of race horses breeding it is necessary to by-pass an old fashioned concept based on the traditional feeding plan were the diet is constituted by hay, oat and pasture. Balanced rations agree to manage the growth of the foals with particular nutritional strategies and have a fundamental role in the planning of winter feeding, a period that associates a low availability of forage together with physiological growth crisis and consequent risk of bone injuries. Nevertheless, in spite of the fact that the scientific knowledge is quite advanced in identifying the best breeding technologies as mentioned above, in practical field conditions it is difficult to find a proper use of them mainly because of the increase of management costs but also depending on the heritage of high cultural traditions . These considerations give a certain importance to the long monitoring period in the thoroughbred stud farm and demonstrate that also in field conditions it is possible to find compromises between theory and practice. In the last years the thoroughbred bred in this farm became more and more clever and a lot of other breeders with a limited number of foals asked to breed their horses there till the sales.

Table 1. Chemical composition of the feeds progressively used in the stud farm(average values of the different years – feed basis)

Feeds	DM %	HFU n	CP %	CF %	Ashes %	EE %	L-Lysine %
Meadow hay	87,0	0,5	6,3	28,7	5,0	1,6	
Flaked barley	89,5	1,0	9,7	3,1	2,0	1,7	
Commercial mixed feed for young horses	88,0	1,0	19,0	7,1	6,0	3,0	1,0*
Dietetic feed for foals (pre-post weaning period)	90,3	1,01	21,0	3,0	6,5	9,0	1,8*
Dietetic feed for yearlings	90,1	1,0	30,2	11,8	13,3	1,1	1,8*

- Values showed in the official formula

Table 2. Rations progressively used in the different years and comparison with the nutrient requirements

	Post weaning (6 - 8 months) F:C = 70:30				Yearlings (9 - 13 months) F:C = 60:40				Long yearlings (14 – 18 months) F:C = 60:40			
Rations	DM kg	HFU n	CdP g	CF %	DM kg	HFU n	CdP g	CF %	DM kg	HFU n	CdP g	CF %
Hay + commercial mixed feed	7,8	6,0	580,0	20,6	8,7	7,0	591,0	19,1	9,61	8,0	576,0	17,8
Hay + flaked barley + dietetic feed	7,9	6,0	645,0	20,1	8,8	7,0	711,0	18,4	9,66	8,0	708,0	16,8
Requirements[1]	5,5 - 7,5	5,5 - 6,0	620	17 – 25,0	7,5 – 9,0	6,5 – 7,0	600	17 – 25,0	9,0 - 10	7,0 – 8,0[2]	600	17 – 25,0

[1] INRA, 1990

[2] This quota included a pre-training physical activity

Table 3. Bone diseas, underweighted horses and race performances in the years 1990 – 2002

YEARS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
N. of heads	14	24	38	31	24	25	30	31	28	32	30	29	32
Bone diseas at weaning (6-7 months) %	57	14	18	18	25	15	23	16	18	20	15	18	16
Underweighted foals (6 – 7 months) %	29	17	32	16	25	15	6	10	10	13	15	13	6
Bone diseas at 16-18 months %	14	5	6	5	4	5	10	10	8	10	5	10	10
Underweighted yearling at 16 – 18 months %	30	22	22	13	23	13	5	0	0	3	10	0	0
Yearlings performances													
- never in race %	23	18	10	10	18	16	7	7	7	9	10	10	-
- never placed %	31	12	23	22	12	16	20	-	25	13	13	20	-
- winnings and/or placed %	46	70	67	68	70	68	73	93	68	78	77	70	-

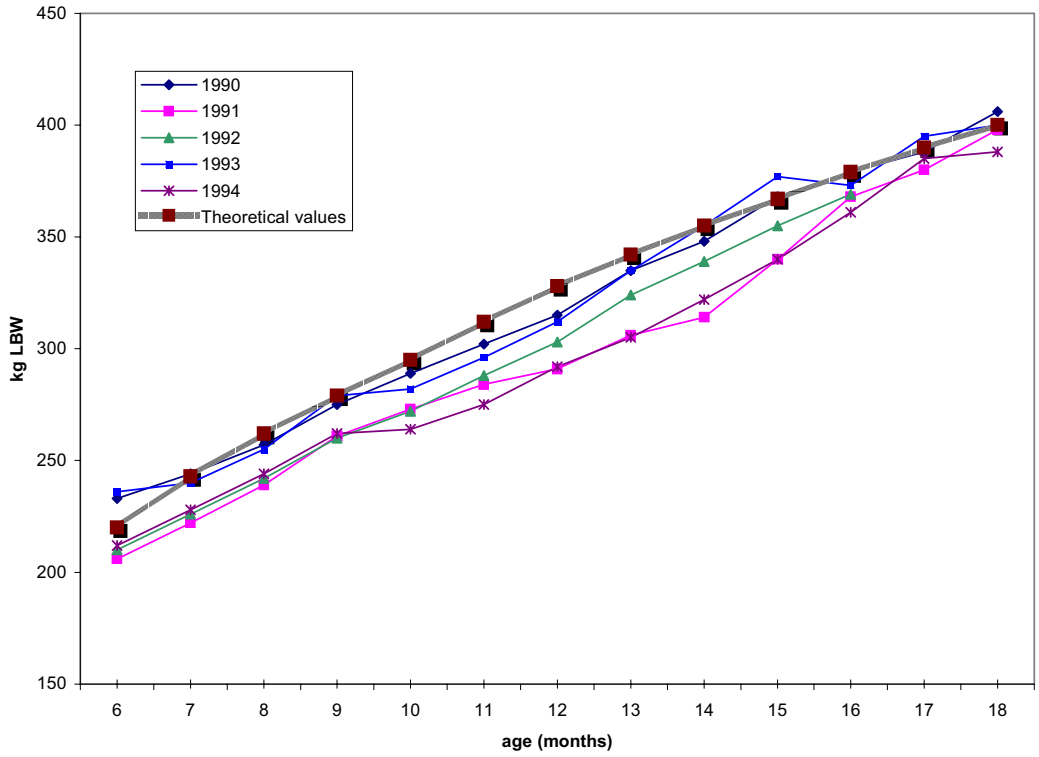

Figure 1. Body Live Weight: comparison between observed and theoretical values in foals born between 1990 and 1994 from weaning to 18 months

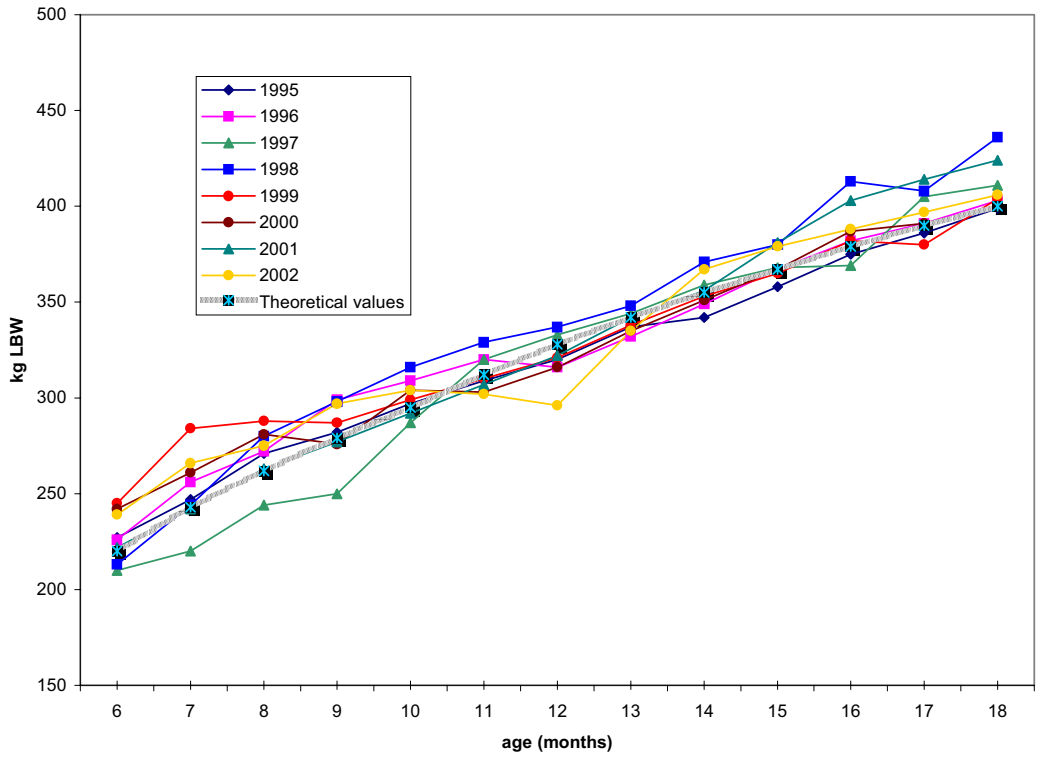

Figure 2. Body Live Weight: comparison between observed and theoretical values in foals born between 1995 and 2002 from weaning to 18 months

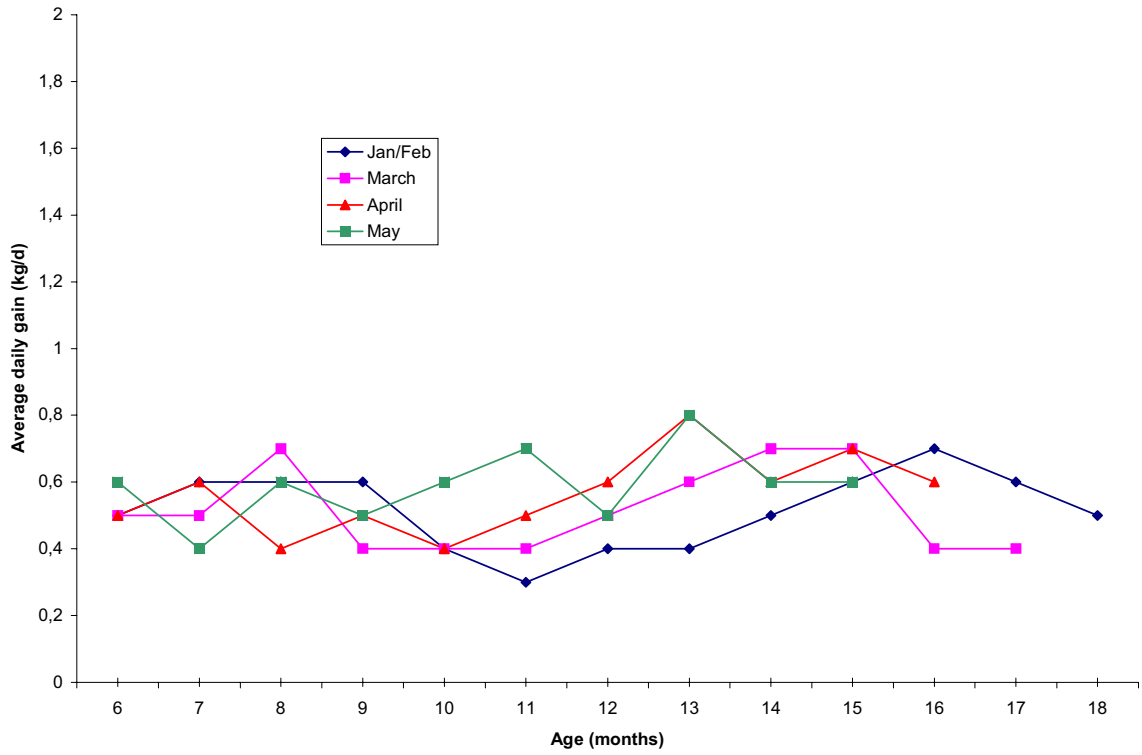

Figure 3. Growth rate of thoroughbred foals in relation to month birth(foals born between 1990 and 1994)

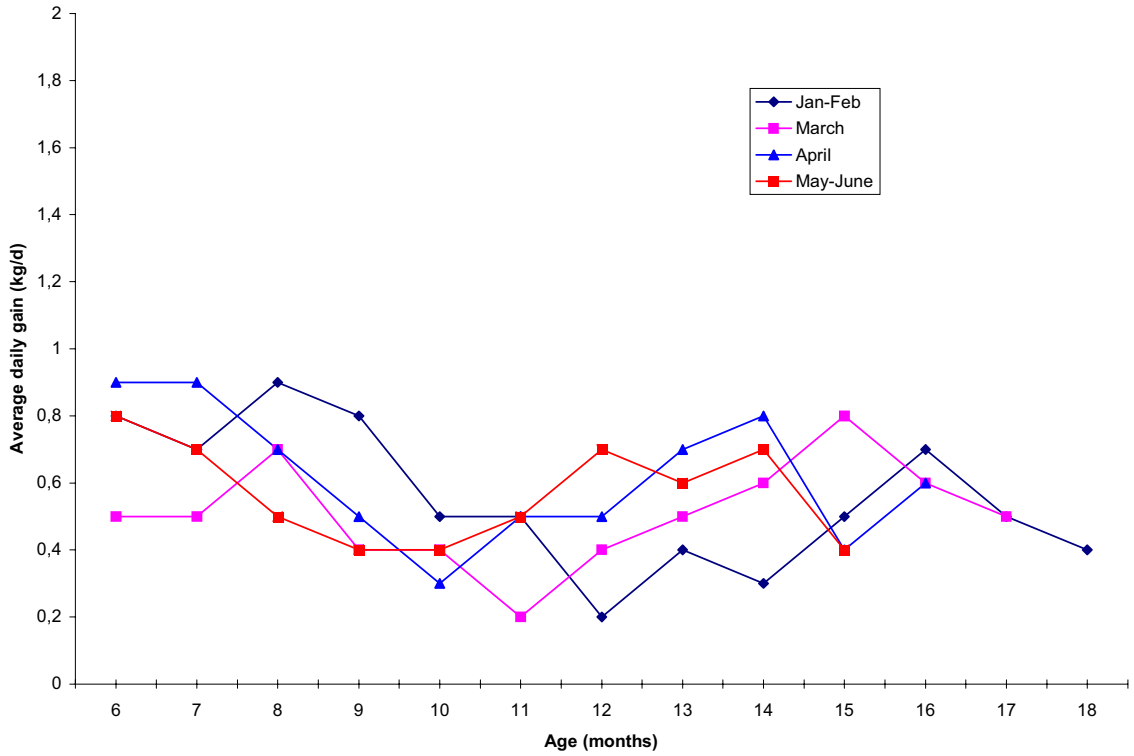

Figure 4. Growth rate of thoroughbred foals in relation to month birth(foals born between 1995 and 2002)

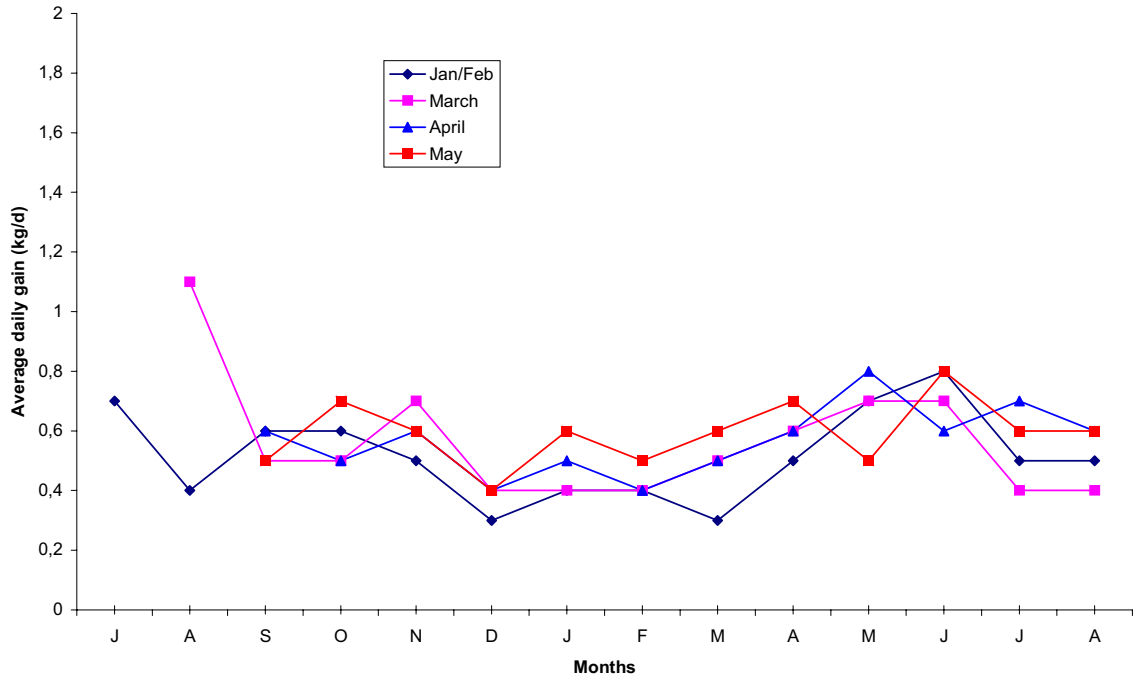

Figure 5. Growth rate of thoroughbred foals in relation to season (foals born between 1990 and 1994)

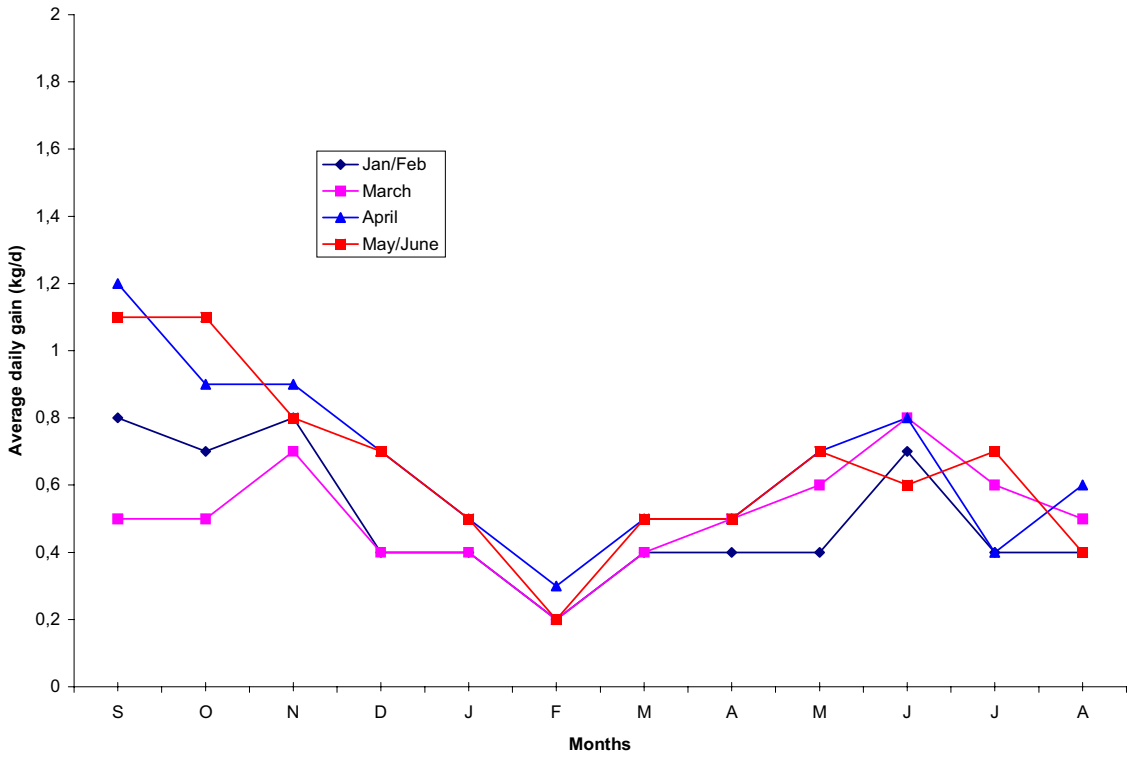

Figure 6. Growth rate of thoroughbred foals in relation to season (foals born between 1995 and 2002)

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