Managing/Feeding the Suckling, Weanling and Yearling and Managing/Feeding the Orphaned Foal

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Managing horses today is full of **'checks and balances'** from birth all the way through FEI. I will include them into my explanations on what, why and how much needs to be fed to horses, based on: 1) their digestive system from birth to 4 months of age, 2) their 'Rate of Growth' from birth to maturity, and 3) their 'Type' and 'Analysis' of the forages (hay and pasture) they are eating. In every phase, the real challenge is to meet 'all' their nutrient needs for health, immune response, growth, performance and reproduction, without getting our Warmbloods too fat.

Let's learn from the past and look to the future:

In the past, the protein levels in 'horse feeds' and 'alfalfa hay' have been blamed for causing everything from 'physitis, contracted tendons, etc', from 'Growing too fast', causing growth and developmental problems. But in reality, the mineral levels in these 'horse feeds' and 'alfalfa hay' did not complement each other and was either 'unbalanced' or 'inadequate' to support 'optimal' growth rates. After 30 plus years of problem solving on breeding farms, we have frequently seen horses being fed adequate amounts of protein with inadequate amounts of minerals, or unbalanced minerals, to support their growth rate, and the problems this will cause. Owners or managers are not looking at the **mineral levels** in the 'total' diets of their horses because they have no idea what minerals are in: 1) the milk their foals are drinking, 2) the hay they are feeding, or 3) in the pasture they are eating. This is very said and needs to change!!

IF a growth, reproduction or performance problem becomes apparent, Managers have been quick to select a 'supplement' to add and hope to see improvements. If they saw improvement, they guessed correctly on what potential nutrition deficiency was causing this. If they guessed incorrectly, they saw no change or improvement. What this really says is: if improvements were seen, their horses were being fed an unbalanced or inadequate diet. They need to reevaluate the 'TOTAL' diet of their horses today.

Farm Managers must also be good 'agronomist's'. The color of your Forage (hay or pasture) does not tell you anything about its mineral density, or the White Milk does not tell you anything about its mineral density, either. The only way to remove the 'guess work' out of feeding is to have the forage and milk analyzed and compare them to the levels recommended in the 'Total Diet', that are necessary to raise healthy horses today. Managers must set up a series of periotic **'checks and balances'** for every stage of life, or physiological status, of the horses they have stewardship over.

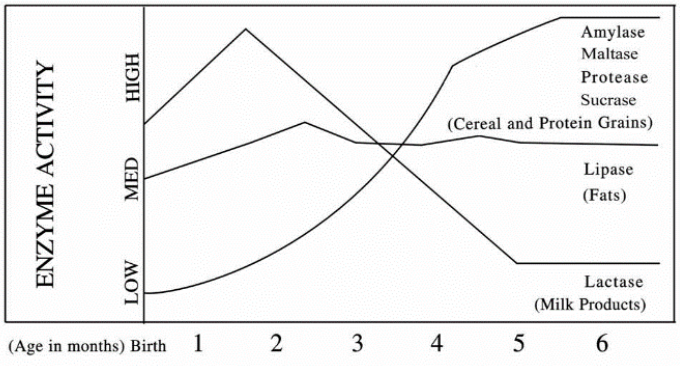
The following is written help farm managers reduce the incidence of 'nutrition related' problems occurring in: reproduction, growing or performance. The more 'stress' on these horses, the more important it is to provide all the nutrients needed to support them.

Here are a few things all horse owners need to understand, to help them manage their foals:

1) The foal's genetics are set **'at conception'**. That means you cannot feed them to grow taller than they are genetically capable of growing. You can feed them: a) adequate protein and calories with 'inadequate' minerals; or, b) **less then** 'adequate' protein and calories needed for sound skeletal and soft tissue development and make them smaller and unsound; c) **however**, you can over feed calories and make them too fat and cause 'trauma' related injuries to occur while growing and developing; and d) you can also over feed NSC's (Grain Mixtures) that can interfere with 'optimal' gut function by lowing the pH and increasing the rate of passage (loose stools), thus, decreasing absorption and utilization of the nutrients being fed. All four of these 'less than ideal' feeding and management problems are known to **cause** the problems that make up 'Nutrition/Management Related' Developmental Orthopedic Disease (DOD) today.
2) Therefore, to start with, everyone must understand the development of the foal's digestive system and how it changes: from birth to 3 months age, then to 6 months, then to maturity. Also, be sure to provide ingredients, the foals can break down, digest and utilize.
    a. Foals are born with a monogastric digestive system and can 'only digest milk'. This means that 'lactase' is the primary 'enzyme' in their digestive system. The other enzymes necessary to break down 'other foods' are not there or in very small amounts. The newborn foal's diet must be 'all milk'. IF and only IF, the mare is not producing enough milk to satisfy the foals appetite, will the foal begin looking for something else to eat. Some mares come into their milk faster than others, but all mares will peak in their 'genetic ability' to produce milk between 4 to 6 weeks after foaling.
    b. When the sucking foal begins to show an interest in eating anything other than mare's milk, that will inform you to provide the foal a food their digestive system can break down and digest, i.e milk! The 'size' of the foal is irrelevant as to WHAT they can digest, **their digestive system changes according to their age, not size.**

MC Roberts published his completed work on: **'The development and distribution of mucosal enzymes in the small intestine of the fetus and young foal'**.

Digestive Enzyme Activity from Birth to Six Months of Age



Kapper, DR, "Applied Nutrition" chapter, editor: Reed, SM, *Equine Internal Medicine*, 2nd Edition Saunders & Co., St. Louis, MO, 2004, pp 1565.

3) A common management practice, in the past, has been to allow nursing foals to eat the 'horse feed' with their dams. Unfortunately, 'horse feeds' are formulated with: 1) minerals to complement the minerals found in forages, and foals' under two months of age, have very little ability to digest forage, or 2) the starches found in 'horse feeds'. Therefore, this is not a good practice because it does not provide a balanced diet for the newborn. Depending on how much is eaten by the newborn, this management practice is one of the reasons young foals develop diarrhea between 5 to 10 days of age! During the foals first few months of life, their digestive enzymes are more efficient at breaking down and absorbing milk (See above chart). As the foal ages, their digestive enzymes change. When the foal is between 3 to 4 months of age, the enzymes amylase, maltase, etc., will surpass lactase, allowing foals to begin digesting the non-structured carbohydrates (NSC) in their stomach and small intestine, that are found in cereal grains and immature forages. **You should choose a 'milk' pellet or a 'milk based' pellet that is formulated with ingredients to complement their digestive enzymes, and amino acids and minerals in their mare's milk, NOT FORAGE!** This will result in optimum nutrient absorption, reducing the chance of digestive upset that can cause loose stools to diarrhea. This 'milk' or 'milk based' pellet should be fed 'ad-lib' until the foal is between 3 to 4 months of age, as the chart above indicates, then begin the switch over to a 'weanling' feed to complement their forage.
    - **a.** The time to introduce the 'milk based' pellet is during their first week of age. At this time, the majority of the foal's appetites are not being met with just the mare's milk and it will be easier to get them to eat the pellet. Be patient, and remember what it was like the first time you tried to feed your son or daughter solid food. IF you wait until the foal is 4 to 6 weeks old and the mare is in peak milk production, it will be nearly impossible to get the foal to eat the pellet. Not because they do not 'like' the pellet, but because they are full of milk, or they are use to eating something else. Yes, foals are creatures of habit. Here are two different foals, learning to eat their 'milk based pellets'. Dare to Dream OBX is 5 days old on the left, and Hampton's Hijinx KFX, is 11 days old, on the right.

    - **b.** IF you do not make a 'milk-based' pellet available, the suckling will find something to eat on their own, to satisfy their hunger. The easiest access for them, will be the mares 'horse feed' or hay. IF you let the foal eat with the mare and that 'horse feed' has molasses in it, it will be more difficult to switch the foal to a milk-based pellet containing no molasses. Yes, they are 'creatures of habit' and will want to continue eating what they have been eating. They will eat and look forward to eating, the first 'food' that is made available to them. Their smell and taste senses are very keen at this age.
    - **c.** This is why it is ideal to keep the mares feed tub up high enough to prevent the foal from reaching it.

d. IF the foal decides to chew on hay, because they are 'teething' or to satisfy their appetite, don't worry if they swallow a small amount. At that age, the 'hind-gut's' fermentation vat is not functioning and the stems will come out of the rectum tomorrow in the same length and form they went in today. This is because it takes a 'fermentation vat' to break down the fibers before digestion can occur. This is another reason to make sure the 'softest' hay is given to the lactating mare. Softness in an indicator of its maturity when harvested, and the softer the hay, the easier it is to digest and the more the mares can eat per day. **This would be a Grade 1 Hay, or a Relative Feed Value above 125.** It is also the best hay to supply the lactating mare, to meet her increased nutrient demand to reach and maintain her peak milk production and body condition.

e. By 4 months of age, the foal's digestive enzymes will have changed and they can for effectively digest weanling feeds and forages. Therefore, select a weanling 'feed' that: 1) will complement your forage: Type and Maturity level (RFV), and 2) is formulated adequately for the young, growing horse, with higher percentages of nutrients to support their growth rate, i.e. genetics.

f. **Now let's look into the different 'checks and balances' I was talking about earlier.** We select what we feel is the best 'total diet' to feed the nursing mare, i.e. forage and 'horse feed', in hopes of meeting her needs to produce milk up to her genetic potential and the 'quality' that will grow the suckling 'optimally' and assure good health, growth and development. We do our first check by analyzing the mare's milk on days: 5, 30 and 60 after foaling. We do this because mare's milk is constantly changing in nutrient density and we need to know how much.

Here are the 'checks and balances' for mare's milk, by week of lactation:

Mare's Milk Nutrient Composition by Week, on a Dry Matter Basis

	kcal/100g Energy	% Protein	% Fat	% Lactose	% Ash (b)	% Calcium	% Phosphorus	% Magnesium	% Potassium	% Sodium	mg/kg Copper	mg/kg Zinc	mg/kg Iron [c]
Birth Colostrum	536	75.79	2.78	18.25	2.86	0.34	.16	.19	.45	.21	3.93	25.40	5.20
12 hrs.	557	33.04	20.87	41.74	4.35	0.68	.35	.12	.84	.32	7.22	24.40	8.26
24 hrs.	544	28.95	21.93	45.61	4.65	0.85	.39	.10	.74	.30	6.40	31.60	9.21
1 - 4 wk	542	25.23	16.82	57.94	4.91	1.12	.68	.08	.65	.21	4.21	23.36	7.99
5 - 8 wk	505	20.95	16.19	60.95	3.81	0.95	.57	.06	.48	.18	2.48	19.05	6.29
9 - 12 wk	500	18.00	14.00	65.00	3.00	0.80	.50	.05	.40	.15	2.00	18.00	4.90

[A] NRC 2007, Nutrient Requirements of Horses

[b] Ullrey, DE., Struthers, R.D., Hendricks, D.G., and Brent, B.E., 1966 Composition of Mare's Milk, Jan. Sci. 25:217
[c] Ullrey, D.E., Ely, W.T., and Covert, R.L., 1974. Iron, Zinc and Copper in Mare's Milk, J. Anim. Sci. 38:1276

g. If the mare is fed inadequate minerals in her prenatal and/or lactating diets, she has the ability to 'pull' those specific nutrients from her body reserves to assure the foal will receive what they need prenatally and in her milk, through her 'homeostatic mechanism'.

The results of these 'deficiencies' will not be visible until the mare's body has been 'mined' and she has nothing left to give to her foal. This is when we will begin to see those deficiencies in her foal. To stay ahead of this, we recommend analyzing the mare's milk and comparing it to what the 2007 NRC for Horses states is 'optimal' nutrients to grow a suckling by the month. When we compare the mare's milk analysis to the 'mares milk nutrient density chart', we can see if all the requirements are met or not, BEFORE any 'visual' problems occur. IF the foal needs just trace minerals (they are found in the **paste form**) or IF both major **and** trace minerals are needed (they are found in the **liquid form**), there are products on the market called: **Rejuvenaide or Leg-Aide or Foal-Aide** to administer in paste and liquid forms, depending on the deficiencies found in the mare's milk. These are administered daily, by drenching the foal, based on their size and the amount of these minerals needed per day. Because the minerals in mares milk is constantly changing, another milk analysis should be completed and compared to the nutrients needed every 30 days. These daily recommendations will be based on how fast the foal is growing, i.e. current body weight, and the amount of these essential nutrients found in the mare's milk.

h. Here is one of my mares' milk analysis from day 6, and the comparison to the 2007 NRC for Horses Chart, from 5 to 30 days after foaling. I am very pleased with these results and will not be needing to 'add' anything into the foals' diet per day to assure optimal skeletal and soft tissue development for the next month. As you can see, the only nutrient less than 90% in her milk is sodium. If the milk is low in sodium, it is common for the suckling to find and eat too much salt, when it is provided ad-lib. The first visual, if they over consume salt, is loose stools to diarrhea. Remove the free choice salt from the foal if this occurs, but make sure the mare still has access.

We recommend analyzing your mares' milk again at 30 days after foaling and compare it to what the foal needs to grow optimally between 30 to 60 days, and again between 60 and 90 days. If necessary, administer the 'drench' according to the amount of nutrients found in her milk during that time and the foals body weight.

Example: Mares Milk Analyzed on day 6, compared to the Horse NRC's minimum amounts needed

	Milk Analysis Results	2007 NRC Milk values from days 5-30	% of Actual to the 2007 Horse NRC Values
Percent Solids(%)	10.76	10.70	100.56
Crude Protein (%)	27.22	25.23	107.89
Calcium (%)	1.03	1.12	91.96
Phosphorus (%)	0.75	0.68	110.29
Potassium (%)	0.73	0.65	112.31
Sodium (%)	0.18	0.21	85.71
Copper (mg/kg)	4.00	4.21	95.01
Zinc (mg/kg)	22.00	23.36	94.18
	Color Code:		
	Green = >100% Meets Nutrient Requirements		
	Yellow = 90% to 99% of Nutrient Needs		
	Orange = 75% to 89% of Nutrient Needs		
	Red = < 75% of Nutrient Needs		

i. By 90 days of age, the foals are usually eating some forage and their appetite is increasing because the amount of mares' milk is decreasing. Now is the time to begin making the 'transition' off the 'Milk Based' pellet and onto a 'Weanling' feed that is formulated to complement the amino acids and minerals in your forage (hay and/or pasture). Go slow making this transition, i.e. take at least 2 weeks, mixing them together.

Using this **'Foal Feeding Program',** you can: 1) match the changes in the growing foal's digestive system, 2) reduce the chance of digestive upsets, and 3) meet their nutrient needs to support their health, growth and development. This 'Feeding Program' will deliver the proper skeletal and soft tissue development, and the lean muscle mass you desire, resulting in a healthier foal that can grow up and reach their full genetic potential.

That brings us to the 'rate of growth' question. All foals grow at different rates and at different times. It is up to the manager to monitor their monthly growth and supply them with the nutrients they need to support their particular growth rate, to assure they reach their genetic potential (whatever that is). We know in every specie of animal, the faster they grow the more amino acids and minerals are needed to support their growth rate. We have learned from the research completed in other species, calves, pigs, chickens, etc., when the genetics change and they grow faster, or mature earlier or larger, their 'prenatal' and 'growing' diets must change to support them. For example: 1) pigs had a real problem with OCD's in their larger, faster growing young stock. It was not until they changed their management and nutrition did the incidence decrease. This change was implemented during their prenatal and growing months, by increasing the amino acids and minerals to meet their 'new' requirements; 2) calves had a real problem with physitis and acquired contracted tendons until they improved their 'prenatal' and 'weanling' diets to compliment their larger structures; 3) breeders of broilers and turkeys changed their genetics so much, when they grew more muscle mass, their legs could not hold them up. They successfully addressed their 'chick' diets and 'growing' diets by increasing their amino acids and minerals to support their faster development and larger size. When we started doing research at The Ohio State University in the early 1980's, we reviewed all of this research first, to determine which minerals and at what level did they increase to see these improvements. We then began a four-year study on 'prenatal' needs AND 'growth' needs. The results of this study have been successfully used on breeding farms ever since. Our published data resulted in the 'change' of major and trace mineral concentrations in the formulas of horse feeds throughout North America today. So, now you know why they call it RESEARCH and not SEARCH!!

After the increased amount of nutrients were provided to the mares and foals, we needed a way to monitor their monthly growth easily AND inform managers how much more amino acid and minerals were needed on a daily basis to support those faster growing foals.

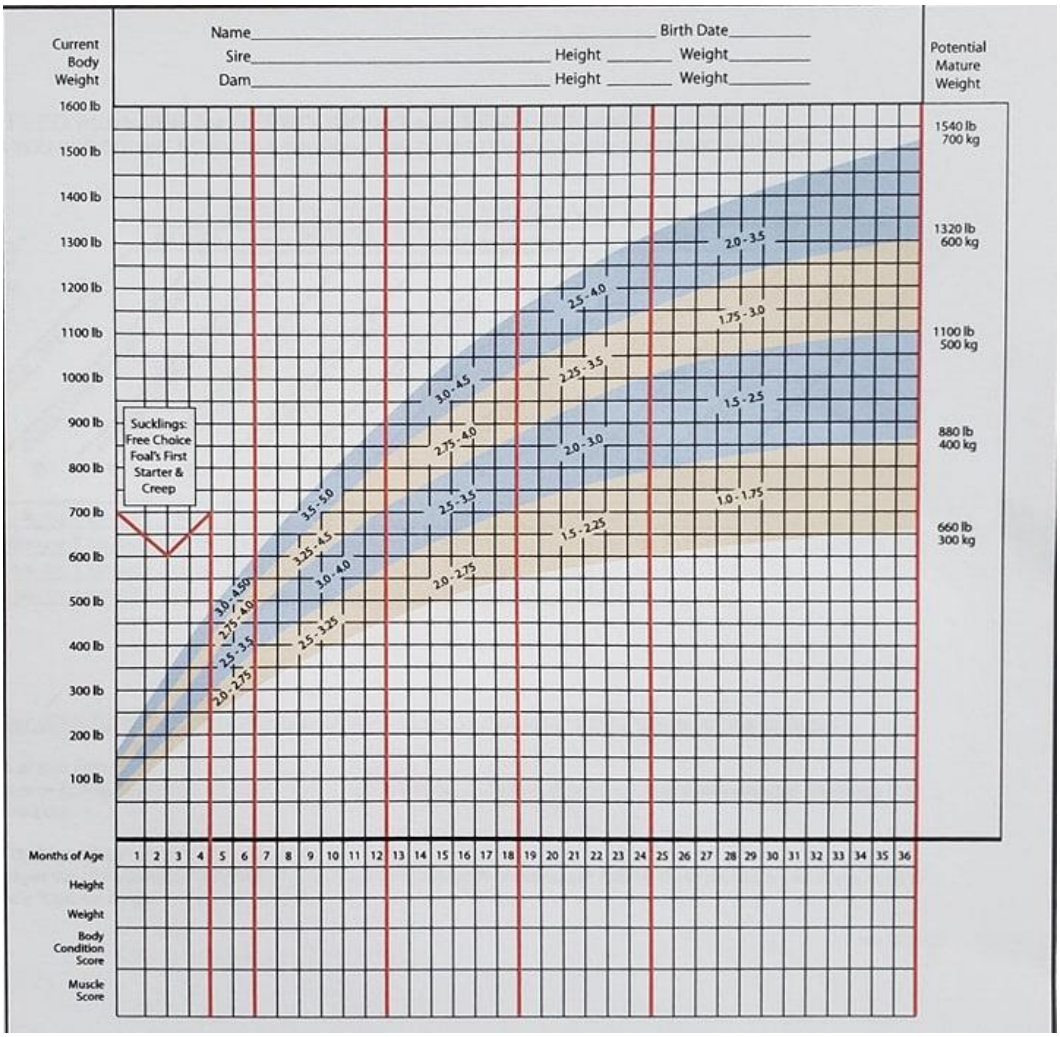
We developed a 'Growth Monitoring Chart', (see below) based on the increase in minerals as stated in the NRC for Horses, based on size and how fast they were growing, then included how many pounds of a Ration Balancer it would take to meet those increased needs, without providing extra calories that could make them too fat, i.e. BCS of 6.0. If you look at the chart below, it is the chart that was published in the Veterinary Textbook, *Equine Internal Medicine*, 2nd edition, in 2004, to help all breeding horse farms. This

set the standard to help all managers and veterinarians, rule out nutrition from being a limiting factor in 'Developmental Orthopedic Disease'.

Over 30 years of continued research and monitoring feeding trials, (remember the checks and balances), when over 25% of an individual farm's foals were affected by any of the forms of DOD, we were able to reduce the incidence in their next foal crop, by 80%, i.e. same mares. **We emphasized:** 1) Prenatal nutrition the 'entire' pregnancy; 2) The lactating mares were fed the 'Recommended Allowance' of nutrients based on the month of lactation; 3) analyzed mares milk and administered the 'foal paste or liquid' according to the foals age, size and mares milk mineral density of each lactating mare; and 4) monthly growth monitoring, to provide the amino acids and minerals to complement each foals month of age and body weight, i.e. growth rate. It is our job to keep up with them, **not** try and slow them down to what we think they should be to fit into our schedule!!
The numbers you see inside the rectangles on the Growth Monitoring Chart below, are the minimum pounds of the 'Young Horse' Balancer to feed per day per head. If extra calories were needed, they were added separately until their desired body condition score (BCS) was attained.

Measuring their Growth and recording it every month, pointed out very quickly, that all foals do not grow at the same rate, and it was necessary for the managers to provide the nutrients needed to support their growth rates. Some of the horses grew faster and at a rate to mature at 1600 lbs, but then slowed and actually matured between 1100 and 1200 lbs. Others grew slower, but grew for a longer period of time, maturing between 1100 and 1200 lbs. We learned, if we feed all the young horses for 'average', then all of our 'average' horses were OK! We MUST feed to compliment your breeding program, i.e. genetics, and be sure to provide all the nutrients needed every day, especially if they are growing at a faster rate. When the young horses slow down their rate of growth, the manager should adjust their feed accordingly. Otherwise known as: 'put your money where you will get the best return on your investment', i.e. into your young, growing horses, accurately.

GROWTH MONITORING CHART: *On the left side of the chart is each foals current body weight. On the right side, is their 'potential' mature body weight. The lines drawn in-between are taken from the 2007 NRC for Horses, showing the different 'rates of growth', based on their average body weights. On the bottom of the chart is their month of age. Every month, weigh each foal and plot their growth on this chart to determine how many pounds of a 'Young Horse' Balancer to feed per day to complement their needs. Some foals grow faster and need more amino acids and minerals, while others grow slower and need less. The numbers inside each 'rectangle' are the pounds (minimum and maximum) of a 'Young Horse' Balancer to feed per day, to complement the young, growing horses nutrient needs.*



You can tell if a Balancer is formulated for 'young horses' by the amount of Selenium and Salt in their formula. The recommended amounts for 'young horse' Balancer are: Selenium = 1.5 ppm (or mg/kg); Salt = between 1.0 and 1.5%. This is necessary to stay under the maximum legal amounts fed per day of Selenium and to maintain palatability with salt. (If more salt than this, they will not eat it) If the amounts in a Balancer are higher, it is formulated for mature horses, and fed to them in smaller amounts per day. This is the easiest way to determine 'young horse' vs. 'mature horse' Balancer.

If the forage you are feeding to your pregnant and nursing mares is a **GRADE 1**, (a Relative Feed Value (RFV) >125) and it is offered ad-lib 24/7, most warmbloods will get along fine with just feeding a Balancer, i.e. pounds listed on the Balancers 'Feeding Directions' per day. IF the hay is a **GRADE 2**, more calories may be needed for your better milking mares and growing weanlings to maintain their desired body condition. We then recommend you add a 'fat/vegetable oil' source into their diet. An extruded, high-fat feed (25% Fat) is recommended, for palatability reasons. IF the hay is a **GRADE 3 or 4** (RFV between 75 and 102**)**, we recommend feeding a: 1) Growth Feed to your nursing mares, weanlings and yearlings, with 'added' fermentable fiber sources, or 2) mix your own 'Growth' feed by making your 'custom' formula 33% Balancer and the other 66% from: 1) whatever 'form' of calories you want to use, and 2) the amount of flaxseed oil/soybean oil (50/50 mix for example), and 3) good sources of fermentable fiber, i.e. beet pulp, alfalfa pellets, or soybean hulls, whatever combination you feel comfortable using. Realizing this 'Growth' feed will provide you with 1 lb of Balancer for every 3 lbs you feed, you can use the following chart to help you provide the correct number of calories you need to feed per day to maintain optimal BCS, and top-dress the Balancer to meet your horses amino acid and mineral needs. This is true if you feed less then 3 times the smaller number listed on the above Growth Monitoring Chart, of the 'Growth' Feed.

For example: If your weanling needs to be fed 3.0 lbs of Balancer per day:

Number of Calories	**=**	**Balancer**	**+**	**Growth**
1) Lowest		3.0	+	0
2) Higher		2.0	+	3
3) Higher		1.0	+	6
4) Highest		0	+	9
5) Maximum safe		0	+	12

Lines 1 thru 4 contain the same amount of 'added' amino acids and minerals, while Line 5 is the 'safe upper limit' to feed per day. Select the line that will help you maintain their desired body weight, while meeting all of their other nutrients needed for growth and development. **Then the 'Checks and Balances' come into play again.** You must monitor their 'growth plates' and 'tendon strength and elasticity' every month and record all changes. Photos will also help as you look back and monitor changes.

Using our 'Charts' from over the past 30 years of evaluating, the majority of the growth and development problems we see today are nutrition and management induced, while less than 10% is genetic. It is worth the 'extra' effort for managers to feed their growing horses based on their individual needs, complimenting: 1) the nutrients in your forages, and 2) how fast are your foals growing, without getting them fat. i.e. BCS of 5 is ideal.

FYI: The more pounds of a 'horse feed' you feed per day, if you are feeding a **GRADE 3 or 4 Hay,** the more important it is to select a 'feed' with a higher fat and higher fiber percentages. This

will provide you with a lower NSC percentage and a source of fermentable fiber to help maintain optimal hindgut function, i.e. fermentation, reducing the chance of digestive upset.

That brings us to the 'forage' question. All foals are born 'monogastrics', and their small intestine increases in length and diameter from birth to 4 months of age. The hindgut, i.e. cecum to the colon, will begin to increase in size also, but it is between 4 to 12 months of age the greatest changes occur there. This is when the hindgut becomes a 'fermentation vat', so they can digest the forage they consume. The cecum is not very efficient in weanlings and early yearlings, so IF they are fed a **Grade 3 or 4 Hay**, you will see their abdomen become distended and cause, in the true sense of the word, – 'Hay Belly'. Remember, **GRADE 1 Hay will not cause 'Hay Belly'**, because the distention is from a higher NDF percentage, or the amount of indigestible/non-fermentable fiber in the hay. The larger the 'fermentation vat' the more efficiently it operates. So, as they get older and become 'continuous forage grazers', they are able to absorb and utilize more nutrients from their forages (hay and pasture).
Here is a 'chart' based on the 'Forage Grade' to use when selecting hay to feed your horses, to show you what the 'best' hay, i.e. GRADE and RFV, is for your horses, based on their physiological status, i.e. nutrient needs.

Using the 'Relative Feed Value' as a 'Tool' on Breeding Farms

Nutrient Needs:	Forage Grade	Best RFV to Feed
1) Highest Need	1	Over 125
▪ Best for: Lactating, Sucklings, Weanlings		
2) Medium Need	2	103 to 124
▪ Best for: Pregnant, Yearlings, Stallions		
3) Lowest Need	3 to 4	75 to 102
▪ Best for: 'Easy keeping' Open and Pregnant mares		
4) Avoid feeding	5	Below 74
❑ Because there is a high incidence of 'impaction colic' due to the amount of 'over-mature and unfermentable' fiber		

You can see, **GRADE 1 Hay** is recommended for all Lactating mares, Sucklings and Weanlings. The Grade, or the Relative Feed Value, of your hay will be provided by the Forage Laboratory you select to analyzed your hay and pasture. One of the questions I receive the most is: 'What is the best hay for me to feed my horses?' And the best answer is: 'Hay that has been analyzed!' That is the only way you know what you are feeding and how much of each nutrient needs to be added to meet your horse's needs, without guessing. Remember, the ONLY reason to feed ANYTHING in addition to forage, is to make up the differences between what nutrients are in your forage and what your horse needs. If you don't know what nutrients, or their amounts, are in your forage, you are guessing on what you need to add everyday. And, you will not know

until you begin to see skeletal or soft tissue, 'developmental problems' occur, how good a guessing job you did or didn't do. By the time the inflamed physis or acquired contracted tendons 'visible' in your young horses, some damage has already occurred! How fast you react to these 'visuals', by suppling the nutrients in their required amounts, will determine if and how much your young horse may or may not improve. Unfortunately, you normally find out the answer when you put your horse in training as a 3 or 4 year old, and they do not hold up to the stresses that occur as they move up the levels. This will let you know how expensive the guess work was, when they were young and growing.

Horse: Relative Feed Value (RFV)

The higher the RFV score in forages, the more Palatable and Digestible it is.

The table below lists:
a) the Forage Grades
b) the nutrient ranges of ADF % and NDF %
c) their Relative Feed Value is
e) Hay Intake per day, as a % of their Body Weight (how much can they eat per day?)

Forage Grade:	If the ADF is:	If the NDF is:	Then the RFV is:	Forage Intake is:
Prime	Under 30	Under 40	Over 151	>3.0%
1 (Premium)	31-35 41	-46	150-125	3.0-2.6%
2 (Good)	36-40 47	-53	124-103	2.5-2.3%
3 (Utility)	41-42	54-60	102- 87	2.2-2.0%
4 (Utility	43-45	61-65	86- 75	1.9-1.8%
5 (Avoid)	Over 46	Over 66	Under 74	<1.8%

This table is from the veterinary textbook, *Equine Internal Medicine,* 2nd Edition, 'Applied Nutrition' Chapter. Don Kapper, PAS, author and Stephen Reed, DVM, editor

If you have adequate pasture available for your horses to graze, you need to analyze your soils and work with an agronomist to assure you provide 'healthy' forage for your horses to eat. That means, put together a 3 or 4 year program, to know if and how much 'lime' in necessary to help maintain the desired pH of the soil to optimize nutrient absorption by the plants from the soil each year. Apply these applications in the spring and autumn, because it takes six months for the lime to have a positive affect on the soil pH. Then apply the necessary other nutrients (Nitrogen, Phosphorus, Potassium) after the soil pH is consistently between 6.5 and 7.0. Apply at least twice per year on your pastures, or if this is your hay fields, divide the total amount recommended per year, by the number of cuttings you anticipate, then 'top-dress' the soil right after each cutting of hay. If this is not followed, it is called 'mining' the soil. When the nutrients are not available to the plants, they are not healthy. You cannot expect a horse to eat unhealthy plants and remain healthy!

Then, here come the 'checks and balances' on your hay to see how well your fertilizer program is working. 30 days after you have baled your hay and put it into storage, get a 'hay corer' and drill into at least 6 to 10 bales of each cutting and fill a quart zip-lock container and send it to the

lab, with accurate identification for future use. If you are managing a breeding farm, you need to know the Crude Protein, Heat-Damaged Protein, MCal's of DE/lb, ADF, NDF, RFV, Major Minerals (Ca, P, Mg, K, S) and Trace Minerals (Mn, Cu, Zn, Fe). Your horse's diets need balanced for all of these nutrients (NOT just protein). Now you can compare the nutrients in your hay to what is 'optimal', to see if your fertilizer program is working. The chart below will show you the 'Optimal Range' of each nutrient based on your forage 'Type', i.e. 1) Grass, 2) Mixed Grass and Legume, and 3) Legume. The eight nutrients known to vary the most from 'type to type' of forage are listed in **BOLD print** in the chart.

The following chart is a management tool for you to use and compare your forage print-out to, on a dry matter basis. If the nutrients on your hay analysis report are with-in the following "ranges" under your forage TYPE, then proceed by feeding the recommended amounts in pounds per day listed on the 'Feeding Directions' on every Horse Feed or Ration Balancer. If the forage is **'Grade is 3 or 4'** , or the **RFV is lower than 102**, or **your hay 'analysis' is outside of the following ranges**, you will need to 'adjust' the number of pounds fed per day of the 'Horse Feed' or 'Balancer', to compliment the nutrients found in your forage.

These Expected Nutrient Ranges are Based on: 1) Your 'Type' of Hay,
2) The GRADE is 1 or 2, or when the Relative Feed Value (RFV) is Between 103 & 150.

The GRADE and RFV are Indicators of How Digestible Your Hay Is Today

Nutrients	Grass Forage Analysis	Mixed Forage Analysis	Legume (Alfalfa) Forage Analysis
Dry Matter	87.0 – 92.0 %	87.0 – 92.0 %	87.0 – 92.0 %
Crude Protein%	**9.0 – 15.0 %**	**12.0 – 18.0 %**	**18.0 – 24.0 %**
Lysine %	**.30 - .51 %**	**.51 - .76 %**	**.91 - .1.22 %**
Crude Fat %	2.0 - 2.4 %	2.3 - 2.7 %	2.6 - 3.0 %
ADF %	40.0 - 31.0 %	40.0 - 31.0 %	40.0 - 31.0 %
NDF %	**60.0 - 45.0 %**	**56.0 - 43.0 %**	**53.0 - 41.0 %**
DE Mcal/lb	**.86 - .95**	**.93 - 1.10**	**1.00 - 1.17**

Optimal Ranges of Major and Trace Minerals found in all Three 'TYPES" for Forages Today

Calcium %	**0.25-0.80 %**	**0.80-1.20 %**	**1.20-1.80 %**
Phosphorus %	0.20-0.30 %	0.25-0.35 %	0.25-0.35 %
Potassium %	**0.80-1.50 %**	**1.50-3.00 %**	**2.00-3.50 %**
Magnesium %	**0.15-0.25 %**	**0.20-0.30 %**	**0.20-0.35 %**
Sulfur %	**0.15-0.30 %**	**0.20-0.35 %**	**0.25-0.35 %**
Manganese ppm	40-70 ppm	40-60 ppm	40-50 ppm
Iron	60-200 ppm	60-200 ppm	60-200 ppm
Copper	2-10 ppm	4-10 ppm	4-10 ppm
Zinc	12-26 ppm	14-26 ppm	14-28 ppm

Forage GRADE and Relative Feed Value (RFV) is the best way of determining the digestibility, or availability, of the nutrients within the plant. If your forage RFV is under 102, we would expect the nutrient analysis to be lower than those listed on the chart above and the amount of your 'Horse Feed or Balancer' may need to be increased to meet your horses' nutrient needs.

I. The **nutrient 'amounts'** within the plants are affected by:

1) 'TYPE' of forage, (grass vs. legume)
2) 'RFV' = maturity at harvest, (how course or thick are the stems)
3) soil type the hay was grown on and its pH
4) amount of fertilizer applied per year
5) amount of rainfall during the growing season
6) ambient temperature during the growing season

II. The **nutrient 'availability'** is affected by the RFV of the plant when harvested, i.e. the GRADE.

This **'Foal Feeding Program'** involves the 'total' management picture, **with all the optimal 'checks and balances' to use along the way.** Not utilizing every step recommended, will leave a hole in your breeding and raising program. It costs too much money today, to guess or to wait until a problem occurs, then try to fix it. **'Nutrition is the Science of Prevention'**, use it to the best of your ability.

The bottom line: breed the size of horse you want to raise, then feed them as individuals and allow them to grow up to their genetic potential. Trying to 'slow their growth rate down' increases the chance of 'causing' DOD in your young horses. Feed them what they need, balance their 'total' diet and let them grow, so you can enjoy them when they are ready to perform!

MANAGING AND FEEDING THE ORPHANED OR REJECTED FOAL FROM BIRTH TO 4 MONTHS OF AGE

Author: Don Kapper: Retired, Director of Equine Nutrition of: Progressive Nutrition and Buckeye Nutrition
. Board Member: The American Hanoverian Society

Each foaling season, a number of foals are orphaned, rejected, or the mares have no milk (agalactic). The following is a highly successful program for raising these foals, having been implemented at several universities; veterinary neonatal hospitals and on many horse farms. Foals raised on this program will grow and mature the same as non-orphans and will attain their normal size. In fact, when orphans are raised according to the following recommendations, there is no difference between them and those raised on a mare. In fact, in the cases of the incidence of DOD found in foals while nursing some mares, this feeding program will remove the doubt of the quality of the mare's milk. This program is also very easy to implement and manage.

Research was completed, as a Masters Thesis, at The Ohio State University (1), comparing the different growth rates of foals remaining on mares and provided a milk-based pellet in a creep, to foals weaned at three days and fed a foal's 'all-milk' milk replacer, ad-lib, and provided a milk-based pellet in a creep feeder. Researcher's recorded weekly measurements of their body weight, heart girth, body length, wither height, hip height, and cannon bone circumference. Results showed that foals developed similarly in skeletal size and all foals received similar body condition scores (BCS) and were healthy. These foals were not negatively affected by early weaning and did not develop bad habits.

This 'Feeding Program' will be helpful to those who are managing foals who are: orphaned, rejected, out of mares with no milk or weaned early. Early weaning occurs when a mare is put back into competition, or she is an older mare and you want to reduce her stress level and breed her back, or has had a mastectomy.

COLOSTRUM FIRST:

Colostrum, or the mare's first milk, contains high levels of 'whole protein antibodies' to protect the foal from disease. Mares normally secrete colostrum up to 24 hours after foaling. Foals will absorb colostrum up to 24 hours after birth, or until an adequate amount of the whole protein antibodies are absorbed through their small intestine. The quicker we can get the colostrum into the foals, the faster those openings will close. When possible, we recommend when the foal is sternal and has developed a suckle reflex (you can see and hear them suck on their tongue), milk 3 to 4 ounces of 'colostrum' from the mare, put it into a bottle and give to the foal before they stand. All new born foals need colostrum, ideally, beginning within the first hour after birth. A 100 lb. foal should receive 250 ml. (approx. 1 cup) of colostrum each hour for the first six hours after they are born. This is a total of 1500 ml, or about 3 pints of colostrum per 100 lbs. of body weight. Therefore, all breeding farms should have a minimum of 3 pints of frozen colostrum in storage. When needed, it should be removed from the freezer and thawed at room temperature or in a warm water bath. Pour the colostrum into a bottle, which has a 'lamb'

nipple with the 'X' opening at least ½ inch wide, and let the foal suckle. **NEVER microwave the colostrum** because that will 'destroy' the whole protein antibodies and render them useless.

Provide an 'All-Milk' Equine Milk Replacer 'Powder in Solution' (2) Next:
After the colostrum has been consumed, introduce the foal to the **Equine Milk Replacer** powder mixed into a liquid solution. You may start them drinking from a shallow plastic bowl or from a bottle with a lamb nipple attached, depending on how aggressive the foal. Most of the time a bottle with a nipple is not necessary because the foal will learn to drink from a shallow bowl or bucket very quickly after birth. Teach your foal to drink by placing your finger in their mouths to stimulate the suckle reflex. While they are sucking, raise the small bowl containing the 'warmed' liquid milk replacer solution up to their muzzle. After they begin to drink while sucking, slowly remove your finger from the foal's mouth. If he stops drinking, repeat the above steps until they keep drinking by themselves. Remember, always bring the milk up to the foal; **do not force the foal's head down into the container.** The first day, warm the liquid milk replacer up to the mares body temperature to encourage consumption. When the foal drinks without assistance, hang a bucket with the milk replacer solution in it from the stable wall at the foals' shoulder height. This will allow the foal to drink whenever it wants, <u>just like the mare was there.</u> The bucket should be a contrasting color to the wall to make it easy for the foal to find it initially.
The selected ingredients in a foals food are based on the foals ability to digest them and help maintain the natural pH level in their digestive system. Make sure to follow the mixing directions of 1 lb of powder per 1 US Gallon of water, to make a 10% solution, the same as mare's milk. To assure the equine milk replacer powder is 'all-milk', look at the percentage of fiber listed on the feed tag. It must be less than 0.2% Crude Fiber or 0.40% Acid Detergent Fiber. All milk replacers containing 1.0% Crude Fiber or higher, will contain a protein source that is less expensive, but not as digestible to the newborn foal. Any protein source other than milk can cause loose stools to diarrhea in the young foal.

Mixing the Milk Powder into Solution:

Use the following chart to mix the 'All-Milk' Foal Milk Replacer powder into water to assure the correct amount of milk solids (10%) for the foal to drink. This is the same as mares' milk that all foals need. Making it more or less concentrated can cause digestive upsets to occur, depending on how much is consumed at one time. Once the foal is drinking by themselves, mix the solution at room temperature.

US Gallons Water	Pounds of Power
1.0	Plus 1.0 lb.
2.5	Plus 2.5 lbs.
5.0	Plus 5.0 lbs.

When fed at room temperature, acidified milk replacers will have a tart taste. This tartness discourages a foal from drinking too much at one time when offered free choice. For the first 30 days, foals will average drinking from their dam, or from a bucket, seven to ten times per hour. Feeding this solution 'free choice' will also allow the foal to drink as often as it would if a mare was present. Free choice feeding will greatly reduce the chance of digestive upsets in young foals, because it prevents them from becoming too hungry. IF they run out of milk for over one hour, they will be starving and will drink to much, too fast. **Don't let this happen!**

How Much to Feed/Day?

Mare's will produce between 3.0% - 3.5% of their body weight in milk per day, of a 10% milk solid solution. This means a 1,000 lb. (454 Kg.) mare will produce 30 to 35 pounds (14 to 16 Kg) or about 4 gallons (18 liters) of milk per day. Use the following chart to determine the size of the dam, then select the amount of milk replacer solution to feed the foal every day, based on the amount of milk she would have produced:

Mare's Body Weight		Milk Replacer in Solution Per Day	
250 lbs.	113 Kg	1 gal.	4.5 liter
500 lbs.	227 Kg	2 gal.	9.0 liter
1,000 lbs.	454 Kg	4 gal.	18.0 liter
1,500 lbs.	681 Kg	6 gal.	27.0 liter
2,000 lbs.	909 Kg	8 gal.	36.0 liter

Start feeding the foal just like the mare would --- slowly. Begin by providing ½ of the recommended amount on the above chart on the first day, according to the size of the dam. Then gradually increase the amount provided over the next 7 to 10 days, but no faster than one-half gallon or 2 liters per day, until the recommended amount is being consumed by the suckling. If the stools become loose, slow down, you could be increasing it too fast, or the foal is eating something else. Remember, orphan foals, just like foals drinking from their dam, can develop loose stools between 5 to 8 days of age. Once the foals are drinking the recommend amounts per day, **we recommend mixing the amount the foal should consume in 12 hours (one half of the recommended daily amount), and make it available free choice, AM and PM.**

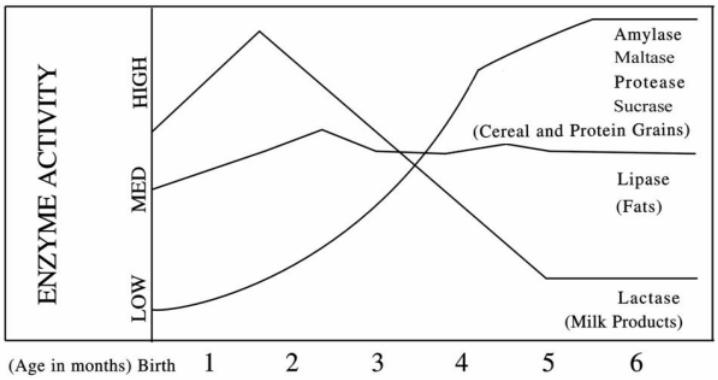
Giving a foal access to milk at all times is feeding the natural way, on demand. Allowing the foal to drink a little at a time, as often as it wants, just like they would from the mare. This will result in fewer digestive upsets, improved milk digestibility, optimal weight gain and improved overall foal health. Each time new formula is mixed, discard any milk not yet consumed and thoroughly clean the bucket before adding fresh milk replacer in solution.

WHEN TO PROVIDE SEPARATE WATER AND BEGIN FEEDING THE 'MILK-BASED' PELLETS (3):
'After' the foal is drinking the recommended daily amount of the **Milk Replacer Powder in solution**, provide water in a separate bucket free choice, right beside the bucket containing the milk replacer in solution. Be sure to wait until all the daily amount of milk replacer has been consumed.
After the foal drinks the recommended amount of the liquid foal milk replacer before the next feeding, add a handful of **Milk-Based** 'pellets' into the same bucket. Foals are creatures of habit and we must teach them it's OK to eat the pelleted dry feed. When it's time for the next feeding of liquid milk replacer, empty any milk pellets left in the bucket and provide the **Milk Replacer** powder in solution as usual. Once the foal begins to eat the **Milk-Based** pellets from the milk bucket, provide them in a separate feed tub, close to the milk and water buckets. Because this pellet is milk based, it can be offered free choice also. **A weanling feed formulated with cereal grains, added fat and fiber, with the added minerals to compliment your forage, is not recommended yet.** During the first two months, the newborn foal will have very small amounts of other enzymes in their intestinal tract, and they also cannot digest forage yet. (See Fig. 1 – below) Maltase is one of the enzymes it takes to break down nonstructural carbohydrates (NSC). NSC's can cause acid gut syndrome (AGS) and lead to loose stools, if too much of a weanling feed is eaten per day. This type of digestive upset can and will decrease the

absorption of nutrients fed, predisposing the foals to nutritional deficiencies that can lead to Developmental Orthopedic Disease (DOD).

MC Roberts published his completed work on **'The Development and Distribution of Mucosal Enzymes in the Small Intestine of the Fetus and Young Foal'**
Journal Reproduction Fertilization 23:717

(Fig. 1) Digestive Enzyme Activity from Birth to Six Months of Age



Kapper, DR, "Applied Nutrition" chapter, editors Reed SM, Bayly WM and Sellon DC: *Equine Internal Medicine*, 2nd Edition, Saunders & Co., St. Louis, MO 2004, pp 1565.

Weaning Time:
When the foal is eight weeks old, begin weaning by reducing the liquid **Milk Replacer**, one gallon (4.5 liters) the first day and replace it by adding one additional pound of **Milk-Based** pellet. Once the foal consumes the added pellets, reduce an additional gallon/day of liquid and provide another pound of the pellets per day. Continue until the pellets replace all the liquid solution. This transition should take about one week. By slowly reducing the liquid milk, the foal will slowly increase the amount of the Milk-Based pellets consumed per day, reducing the chance of digestive upset from occurring.

RECOMMENDED FEED SELECTION FROM BIRTH TO 4 MONTHS, TO COMPLEMENT THE ENZYMES IN THE FOALS DIGESTIVE SYSTEM:

1) Recommend an 'All-Milk', Milk Replacer Powder, mixed into Solution from 1st Day to 2 Months
2) Recommend Adding a Milk-Based Pellet from 3 Days to 4 Months of Age
3) Recommend begin Switching to a 'Weaning' Feed, plus Forage, between 3 to 4 Months of Age

Because the foals are 'teething', place the 'softest' hay you have in the corner of the stall for them to chew. IF they happen to swallow some, it will come out tomorrow in the same form it went in. This is why we recommend the 'softest' hay you have available. Do not to let them get so hungry they are forced to eat the hay, that they cannot digest at this age. You will see their ribs show and a 'distended belly' appear very quickly if not healthy or are too hungry.

HOW MANY POUNDS OF EACH FOAL'S FOOD WILL BE NEEDED THE FIRST FOUR MONTHS?

Foals weighing 100 lbs. at birth, should consume 4 gallons per day and therefore will need (200 lbs) of the 'All-Milk', Foal Milk Replacer Powder until weaned from liquid milk at 2 months of age. They will also need 12/50 lb bags (600 lbs) of the 'Milk-Based' Pellets to be fed 'free choice' to the foal from the first week to 4 months of age. If the foals are larger or smaller, the amount of foal food needed will change accordingly.

If Orphaned 'After' 3 Weeks of Age:

If the foal is 'over' 3 weeks old when orphaned, provide just the Milk-Based Pellet, free choice. At this age their molars are in and they can easily chew and swallow the pellets. Provide the Milk-Based Pellets free choice up to 4 months of age. At 4 months, begin mixing the Milk-Based pellets with a Weanling Feed by subtracting one pound of the milk-based pellets and adding one pound of the 'weanling' feed, every other day. This transition rate is the best way to manage your foals feeding program to reduce the chance of digestive upset and promote optimal growth and development. The weanling feed you select should be fortified with higher level of nutrients needed to support the young weanling's skeletal development and complement the protein (amino acids) and minerals in the 'type' of forage (hay/pasture) your foal is now eating. Check the 'Feeding Directions' on the tag or bag, to find out how much is recommended to be fed per day to meet the young foals' nutrient needs. FYI: Feeding less pounds per day than recommended, according to the foals size, i.e. body weight, will be a nutrient 'deficient' diet!

AGE TO REMOVE ALL MILK:

The Milk-Based Pellet, is formulated for the young foal with a monogastric digestive system. Let the foal eat as much of this pellet it wants, until they are four months old, or their Body Condition Score (BCS) exceeds 5.5. (On a 1 to 9 Scale)

After 4 months of age, it is not necessary to feed milk to a weanling. (See Figure 1) The foals enzymes have now changed and they can begin digesting some non-structured carbohydrates from a weanling feed in their foregut, and soft, immature hay, i.e. structured carbohydrates in their hindgut.

This orphaned or rejected foal and early weaned feeding and management program, will allow the owner/manager to follow the foals' normal developmental changes in their digestive system. It also promotes optimal growth, health and nutrient absorption, while reducing the chance of digestive upsets.

References:

1) Kapper, DR: 'Applied Nutrition' chapter, in Reed SM, Bayly WM and Sellon, DC: *Equine Internal Medicine*, 2nd edition, 2004, WB Saunders & Co. pp – 1581 to 1584.
2) **'All Milk' Equine Milk Replacer powder:**
    a. Buckeye Nutrition's 'Mares Milk Plus' milk powder, 40 lb bag.
    b. Progressive Nutrition's 'Foals First' milk powder, 22 lb bucket.
3) **'Milk Based' pellet:**
    a. Buckeye Nutrition's 'Foal Starter' pellet, 50 lb bag
    b. Progressive Nutrition's 'Foals First' pellet, 50 lb bag