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Nutrition of the Baby Calf

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The successful rearing of baby dairy calves has become a prime target of many dairymen as well as all bovine practitioners because of the increased value of these calves. According to reliable estimates, over 15%, or more than one and one-half million dairy calves are lost annually at an estimated \$150-200 million. As herd size increases, these same surveys show a tendency for these losses to increase. Proper nutrition can be a big factor in reducing these losses.

When considering the nutritional requirements of the young calf, it is important to consider the fact that the digestive system of the baby calf functions much differently from that of the adult bovine.

The young calf at birth has a stomach with four parts like the adult animal; however, the various parts are much different in comparative size. In the young calf, the abomasum or fourth stomach, with a capacity of more than twice that of the other compartments, is the only functional portion. Whereas, in the adult animal, the abomasum or true stomach comprises only 8% of the total capacity while the rumen represents 80% of the total.

In the young calf, the liquid diet is shunted by the reticulo-rumen and is directed into the abomasum by flowing through a tube which is formed by closure of the esophageal groove. The groove which extends from the cardia to the reticulo-omasal orifice is closed by a reflex reaction which is stimulated by consumption of liquids. Milk is the best stimulant, glucose and sodium bicarbonate solution usually are effective stimulants also. Water will effect closure of the groove in the very young calf, but become less effective as the calf becomes older. It has been suggested that the reflex stimulation was evoked by sucking.

However, the stimulation can be evoked by drinking from an open bucket. Stimulation of the glossopharyngeal nerve will evoke the closure reflex also.

Before the milk reaches the abomasum, the only enzyme activity is that of salivary lipase. This enzyme works on butterfat releasing butyric acid.

Minutes after ingesting milk, clotting takes place due to the enzyme, rennin. Pepsin activity starts quite early in life also. As early as five minutes after feeding and continuing for three to four hours, whey is released from the clot and passes into the duodenum, followed thereafter by partially digested casein.

The enzyme activity of the intestine is largely that of lactase. This is why in the very young calf the only digestible carbohydrates are glucose and lactose. Until the calf is about seven or eight weeks of age, there is little maltase, amylase, or sucrase activity. Thus, for the young calf, only milk carbohydrates or simple sugars can be utilized.

The age at which ruminal digestion begins is largely dependent upon the diet the calf receives. The longer the calf receives a plentiful milk supply, the less inclined he is to supplement nutrient intake with other food. Veal calves full fed milk will go in to slaughter at 13 to 15 weeks with little or no ruminal development. However, if liquid diet is limited, the calf will start to consume dry food at a few days of age. These dry feeds pass into the rumen where bacteria and protozoa flora begin to develop. The bacteria flora may be started by backflow from the abomasum at feeding while the protozoa flora development is started by the ingestion of roughage, especially hay. When the ration of concentrates to roughage exceeds 1:1, the presence of protozoa declines markedly.

The young calf can digest concentrates and good quality roughage rather well. However, the digestibility of poorer quality roughage improves as the calf becomes older. The digestive efficiency of rumen fermentation increases with age and reaches the maximum about one week following weaning.

Nutrient Requirements of the Calf

The dry matter intake by the young calf depends somewhat on the form of the food that it is offered. Up until the calf reaches 150 pounds, the dry matter intake will be higher in liquid form rather than in the dry form. The concentration of the liquid feed will also be a factor in total dry matter intake. The higher concentrated liquid feeds up to 25% dry matter will have the highest intake. However, this is only important when feeding veal calves, this would not be true with replacement calves. The maximum dry matter intake in a young calf is about 2.2% of body weight and increases to 3% of body weight by the time the calf reaches 250 pounds. This is about the accepted maximum for the adult ruminant.

Another factor which determines the voluntary food intake of the calf is the digestible energy of the diet. As the digestible energy increases, the intake increases, thus the importance of providing high quality feeds for the young calf. Ambient temperatures will affect the feed intake. The feed intake will be inverse to that of the temperature—as the temperature rises, food intake decreases.

Adequate water supply is a necessary part of calf nutrition. Many factors will affect water intake. Higher ambient temperatures, lowered dry matter intakes, high levels of salt and high protein levels will all increase water intake. When water is offered ad lib, dry matter intake increases. Thus, ad lib water is very important in early weaning programs.

The energy requirements for the calf, just as for any other animal, are divided into two requirements, one for maintenance and the other for growth. The maintenance requirement consists of a requirement for basal metabolism, plus a small loss in the urine, plus the production of heat from any voluntary activity. The maintenance requirement has been determined to be 20 to 24 kcal per pound of body weight. This figure may be somewhat higher for the calf under 10 days of age and lower for the calf over 250 pounds. Considering that whole milk contains about 325 kcal per pound, and an all-milk milk replacer contains about 2000 kcal per pound on a dry matter basis, the young calf needs about seven pounds of whole milk or about one pound of dry, all-milk milk replacer daily for maintenance purposes.

The energy efficiency for growth is very similar to that of maintenance in the pre-ruminant calf. However, at very high levels of feed intake, the efficiency may drop off some. Researchers have shown a range of 1225 to 1675 kcal of digestible energy to put on a pound of gain. So, it will take an additional four to five pounds of whole milk or .6 to .8 pounds of a quality calf milk replacer to put on one pound of gain.

When dealing with the ruminant calf, the efficiency for growth is much lower than for maintenance or for the pre-ruminant animal. The efficiency of the pre-ruminant for growth is about 80% while the ruminant animal is about 50%.

The protein requirements for the calf are determined by the body weight of the calf, plus the amount of weight gain per day plus the percentage weight gain per day. The amount of protein required for maintenance is about 25 grams digestible protein per 100 pounds of body weight and additional 100 grams digestible protein for each pound of gain over and above. These figures are approximate and may vary by which researcher with whom you agree.

The digestibility of protein in the ration will vary greatly according to the source. The protein of whole milk or a good quality milk replacer will be about 95 to 97% while that of poor quality milk replacers may be considerably lower.

Only a portion of the protein that is digested is actually retained in the body. This proportion is termed biological value. The biological value is determined by how nearly the calves' amino acid requirements are met. To reach a level of 100, the amino acid balance would need to be perfect. The biological value for milk is about 90, other sources of protein are less. This factor becomes relatively unimportant in the ruminant animal.

The question is often asked about the utilization by the calf of non-protein nitrogen. It cannot be utilized until the rumen is functioning properly. Once the rumen is functioning, the calf can readily use NPN or urea nitrogen very well. Many studies have shown six- and seven-week-old calves being fed urea with good results.

Mineral Requirements

The dietary mineral requirements of pre-ruminant calves receiving liquid diets are incompletely defined in most cases, because little work has been done on young calves. The requirements of calves for calcium and phosphorus have been well studied and defined. Even here, there exists a large difference in the British and the U.S. standards. The British standards are much

higher. The higher standards should allow for greater and perhaps maximum bone density, which may be a desirable factor when raising replacement calves. The true absorption of dietary calcium decreases with age, but it is markedly affected by the source of calcium. The absorption of calcium from milk is much higher than that from dry feed. When feeding an all-milk calf milk replacer, the dietary calcium requirements are met without any additional source of calcium. However, when other feedstuffs are added to the ration, supplementary calcium will be necessary. The same statements may be made about the phosphorus requirements of young calves. It should be noted that the presence of chronic diarrhea in the young calf will markedly decrease absorption of calcium and phosphorus and also limit retention of calcium and phosphorus.

The calcium-phosphorus ratio has been the subject of much controversy. The NRC suggests a 1.3:1 ratio while the British recommend 1.6:1. However, calves have been successfully raised with ratios from 1.2:1 up to 6:1. As a rule, there should be no need to consider the Ca:P ratio of the diet if the requirements of both minerals are met.

Magnesium requirements do not become a factor unless a calf is left on liquid diets only for two months or longer when typical milk tetany can develop. As soon as the calf receives grain or roughage, its requirements will be readily met from the ration.

The requirement for potassium, which is present mainly in soft tissues, is not specifically known, but a deficiency is only likely to occur in pre-ruminant calves that are suffering from a diarrheal condition. Because potassium is rapidly depleted with diarrhea, it should be part of any electrolyte therapy.

Unlike potassium, sodium is found largely in the body fluids. When feeding a milk diet, the sodium and chloride requirements are met by the natural salts contained in the milk products. In the dry feed ration, supplementary salt at 0.3 to 0.5% of the ration should be used.

The trace mineral nutrition of the young calf can be very complex. In most cases, a normally balanced nutritional diet will meet all needs. However, different geographical areas can encounter various deficiencies because of a particular area deficiency. Thus, in most cases, unless a particular need is known, some supplementation of trace minerals should be done as an insurance measure.

In considering individual trace elements, copper is usually not found to be deficient in this country

in young calves except where molybdenum occurs in large amounts. Iron deficiency is a common occurrence in calves fed solely on milk. Even when the milk product is somewhat supplemented with iron, the calf remains subanemic. This is evident in those calves raised as fancy veal. Ferrous sulfate and ferric chloride are the most available oral forms. The injectable iron dextrans or dextrins are also quite available.

Manganese deficiencies in the dam are said to cause "overknuckling," weak and swollen joints in newborn calves. However, manganese deficiencies have been very difficult to demonstrate in the calf.

Cobalt deficiencies may occur in some areas. Deficiencies will be evident by decreased appetite, emaciation and anemia. However, it is better to supplement vitamin B₁₂ in a cobalt deficiency as the young pre-ruminant will not synthesize vitamin B₁₂ anyway. After the rumen begins to function, it is more economical to supplement with cobalt in cobalt deficient areas.

Zinc deficiencies have been reported. However, the possibility of their occurrence is very limited. Deficiencies would be characterized by decreased weight gain, listlessness and parakeratosis.

Calves can be born iodine deficient; however, deficiency is unlikely from diet. When the dam is fed corn silage as the sole source of roughage, and high levels of soybean meal, calves born with goiterous condition have been reported.

Vitamin Requirements

Vitamin A is very important in the nutrition of the young calf. The calf is born with a minimal reserve of vitamin A and is dependent upon colostrum as an immediate source. However, when the dam is deficient in vitamin A, the colostrum may also be low in vitamin A content.

The pathological signs of vitamin A deficiency are manifold. Vitamin A maintains the integrity of the epithelial cells. The results of a deficiency many times are a diarrheal condition or pneumonia or a combination of the two. The effect on the intestinal mucosa causes not only diarrhea, but has a marked effect in depressing the utilization of protein and the digestion, absorption, and the utilization of energy. Evidence shows that stress caused by poor environmental conditions or by exposure to disease may increase the vitamin A requirement.

The winter requirement for vitamin A might possibly be twice as high as the summer requirement.

The vitamin A minimum requirements, according to both the NRC and the British standards, are about 2000 units per 100 lbs. of body weight

daily. However, it is advisable to use higher levels. About 10,000 units per 100 lbs. of weight daily has been a reasonable recommendation.

The calf requires vitamin D for growth and proper calcification of the bones. Vitamin D deficiency in young calves will show up as rickets even in the presence of adequate calcium and phosphorus. The symptoms may include a diminished appetite and occurrence of digestive disturbances. This is followed by swelling and stiffness of the joints, a tendency of the long bones to be curved, causing a stilted gait and a humped back. These same conditions can be seen when a phosphorus deficiency occurs in the presence of adequate vitamin D. A deficiency of vitamin D has been shown to reduce the digestibility and retention of protein as well as minerals.

The vitamin D requirement for calves is set up at about 300 units per 100 lbs. of body weight. Again, somewhat higher levels are recommended for assurance that no deficiency will occur.

Vitamin E is an important constituent in the diet of the young calf. A deficiency of vitamin E will result in the development of white muscle disease. Vitamin E occurs naturally in cereal grain and hays. However, when high levels of milk are fed, vitamin E supplementation will be necessary. The trace element selenium is intimately linked with the function of vitamin E and a shortage of either will affect the other.

The tocopherols also act as an anti-oxidant; thus their inclusion in milk replacer rations can be very important. The specific requirements for vitamin E will vary depending upon ration, but is thought to be 5 to 15 mg. per pound of dry matter. Some tocopherol will be present in milk products.

The various B-vitamins are essential for the calf. However, all B-vitamins are thought to be in sufficient supply in milk products except vitamin B₁₂. When the ration of the pre-ruminant calf is low in milk products, B-vitamin supplementation may be necessary. The following table includes the suggested daily requirement for the 100 lb. pre-ruminant calf:

Table 1

Thiamine	4.3 mg
Riboflavin	2.0 mg
Niacin	22.0 mg
Pyridoxine	30.0 mg
Pantothenic Acid	8.9 mg
Biotin	0.9 mg
Choline	1200.0 mg
Folic Acid	0.6 mg
Inositol	234.0 mg

Because vitamin B₁₂ is low in milk products, it

is thought that supplementation with at least 10 micrograms per pound of dry matter is necessary for proper growth of the calf until the rumination process is functioning completely.

The first feed received by the baby calf should, of course, be colostrum. The importance of the colostrum very early is well documented. Colostrum feeding should continue for three to four days.

At the time the calf is taken off colostrum, the dairyman has three choices:

1. Whole milk
2. Continued feeding of excess colostrum
3. Milk substitutes or milk replacers.

Whole milk is certainly the most perfect food for the young calf. However, economics and the shortage of the milk make it almost mandatory to look for another source of nutrients for the calf.

Colostrum is a very nutritious feed and all excess colostrum should be utilized. However, a great variation in nutrients can be found in colostrum depending upon how long after calving the colostrum is produced. The variation is demonstrated in the following table:

Table 2

Time After Calving	Percent Total Solids	Percent Protein	
		Liquid Basis	Dry Basis
0	27.4	13.9	50.7
6	27.4	9.3	33.9
12	15.6	4.8	30.8
24	13.9	4.0	28.8
48	13.5	3.6	26.7
96	12.8	2.9	22.7

These variations must be considered when using colostrum. The use of fresh or thawed colostrum which had been frozen, has been successfully fed for many years in this country. After the report in the popular press last year, sour colostrum has become a popular topic. This concept is really not new as it has been used off and on in Europe for over two decades, but because of most colostrum being used fresh, it has not become an extensive practice. Research studies on sour colostrum are very limited at this time. Many research projects are in progress now; thus, next year at this time, we should have better answers. Preliminary results from research stations have been variable. Thus, the use of sour colostrum should be undertaken with care until more answers are known. The problems are protein breakdown, possible contamination by harmful bacteria and toxins. This is especially true in warm weather. Also, in warm weather some users have experienced calf refusal.

In a recent survey it showed that over 70% of our nation's dairy farmers use milk replacers. For a

calf milk replacer to be successful, it must be formulated to not only meet the nutritional requirements of the calf, but that the ingredients are available to the calf. When considering calf milk replacer formulation, all possible ingredients must be considered on their own merits.

Proteins

The various milk products are excellent sources of protein if not damaged in processing.

1. *Skimmilk Powder*—contains about 34 to 35% protein. This protein is made up of about 80% casein, 18% albumin and traces of other proteins. Skimmilk is generally considered the best source of protein, but overheating during processing can cause serious deterioration of the protein quality. Unfortunately, a high percentage of skimmilk powder in the U.S. is exposed to this high heat treatment. Thus, the quality of a milk replacer cannot be judged solely by the amount of skimmilk powder included in the formula. Skimmilk powder as such may be rather difficult to get in suspension because of poor wetting properties, but will stay in suspension once mixed. Thus, a product that mixes easily is not necessarily a high milk solids milk replacer.

2. *Buttermilk Powder*—contains about 32% protein. Buttermilk powder can be considered to be interchangeable with skimmilk powder. However, its availability to the milk replacer industry is limited in the U.S.

3. *Dried Whole Whey*—is a by-product of the cheese industry and contains the albumin portion of milk protein, containing about 12% protein. Dried whole whey is a good nutritive ingredient of milk replacers if it is properly handled and processed. Many people have put limitations on the amount of dried whole whey that can be used when formulating milk replacers. This limitation is not justified if good quality whey is utilized. However, what happens many times is that liquid whey is mishandled, allowing it to become sour and even putrid. Then it is necessary to use large amounts of a neutralizing agent such as sodium hydroxide. This raises the ash content beyond desirable levels, especially the sodium level. At the same time the protein is denatured and the end result is a poor quality product. Dried whole whey can cause physical properties which are undesirable in milk replacers. Dried whole whey can be very hygroscopic and cause a milk replacer to harden or lump when exposed to moisture of the air; thus, it is necessary to be very selective in choosing sources of whey.

4. *Delactosed Whey*—takes in a variety of products. The term delactosed, of course, means

removal of lactose. Depending upon the amount of lactose removed, the protein will range from 16 to 28%. In addition to removing lactose, minerals are sometimes also removed, resulting in a product known as demineralized whey. There is a wide variation in the quality of delactosed whey products. The better quality delactosed whey products are usually called delactosed whey while those of lesser quality are referred to as whey product.

5. *Casein*—As indicated, the major portion, 80% of the protein of milk, is casein. Casein is the protein found in cheese. Large amounts of casein are used in the manufacturing of milk replacers by using approximately one part casein to two parts whey. The result is a product which will analyze similar to skimmilk. Some feel that this product is inferior to skimmilk, but this is only true when poor quality whey is used or if the protein of the casein has been damaged in processing. The casein used in milk replacers is largely imported. About two years ago casein became short in supply; however, in recent months, supplies have again become adequate.

6. *Milk Albumin*—This is the protein portion of whey which is sometimes isolated in the production of lactose. It is not a common ingredient of milk replacers but may be used if available.

7. *Soy Flour - Specially Manufactured*—Until recently, soy flour available for use in milk replacers was not a very satisfactory product. Recently, however, specially manufactured soy flours have been developed which are giving reasonably good results when used under proper conditions. There are a number of different products of this type that have been developed; some have been heat-treated, others have been acid or alkali-treated and there are other undisclosed processes. All of these processes are aimed at destroying the various growth inhibitory factors present in the soybean.

8. *Soy Concentrate*—This is a specialized soybean product where part of the soy carbohydrate has been removed. Soy concentrate has a protein level of 70% instead of 50% in soy flour. The soy concentrates have been reasonably successful similar to the soy flour that has been specially manufactured. However, because of the additional processing costs, it is not as economical as is the soy flour that has been specially manufactured.

9. *Meat Solubles*—the soluble protein that is a by-product of the packing industry. It is composed largely of collagen. It is not a very desirable source of protein for milk replacers because of an improper balance of amino acids. Also, meat

solubles are not very well accepted by the calf and need to be masked by flavors or odors. Meat solubles are widely used in the milk replacer industry because of their handling characteristics, its going into solution readily, and its no-fiber content. When used, the claim “no cereal added” is commonly made or it sometimes is referred to as an “all milk” or “milk base” product. These statements are misleading because this product is actually nutritionally inferior to the improved soy products.

10. *Fish Protein Concentrates*—Fish proteins have long been used in milk replacer. Until recently, most products have been quite unsatisfactory. However, recently, improved products have been developed and are being widely used in Europe. Their success in this country has been limited. Economically they cannot compete in the U.S. with soy protein.

11. *Soy Isolates*—have been widely used in the human field. In theory, the soy isolates would appear to be the soy product of choice for milk replacers. However, this has not appeared to be true in practice. It is the reasoning of some that in the processing of soy isolates, the amino acid balance is upset. The soy isolates have not given results equal to that of the specially manufactured soy flour or soy concentrate.

12. *Soy Flour*—This is the regular soy flour that has not gone through the special manufacturing processes to destroy the growth inhibiting factors. This product has been widely used in low-cost milk replacers with rather unsatisfactory results. Many of the milk replacers available at very low prices would contain this product.

13. *Distillers Dried Solubles and Brewers Dried Yeast*—Both of these products have been used in limited amounts in milk replacers with unsatisfactory results.

14. *Oat Flour and Wheat Flour*—Both of these products, which are very poor sources of protein for milk replacers, have been widely used in low-cost milk replacers with extremely poor results.

Carbohydrates

The most available carbohydrates which can be used by the calf are lactose (milk sugar) or dextrose. Lactose is a major nutrient component of all of our milk products. The lactose content of dried whole whey is 70% and that of skim milk is 50%. High levels of lactose are sometimes incriminated for scour conditions. However, some feel that the quality of the whey may be the culprit. Dextrose or corn sugar is a readily available source

of carbohydrate for the calf. Dextrose should be considered as a source of energy when a scour condition does exist.

Starch and sucrose (table sugar) are not readily available to the young calf because of the lack of maltase and sucrase activity.

Other carbohydrate sources are poor energy sources because of the lack of enzymatic activity in the young calf.

Fats

The addition of fats to milk replacers is very important. There are a number of fats used, with choice white grease (pork fat) and tallow being the most common. In our area, choice white grease is favored because it is readily available in known quality. Coconut oil is used in veal production for carcass quality because it results in a firm carcass. Soy lecithin is used for its emulsifying properties. Soy lecithin is the phospholipid portion of soybean oil. The method of processing of the fat into the milk replacer is important. In fact, it is more important how the fat is incorporated into a milk replacer than the actual source of the fat. The most simple method of incorporation is the blending of the fat into the dry ingredients. This is known as the batch mix method. The second method is blending the dry ingredients with the aid of soy lecithin, which acts as an emulsifying agent. The third method is homogenization of the fat, combining it with the emulsifying agent, soy lecithin, and the reliquified milk ingredients, and spray drying this combination.

Table 3

Fat Source	Batch Mixed	Batch Mixed with Lecithin	Homogenized Lecithin Added
Butter	67%	84	92
Tallow	59	73	86
Grease	51	69	88
Coconut	65	89	93
Average	60	78	90

It can be noted in the above table that the combination of homogenization with the soy lecithin addition is the most desirable method of adding fat to milk replacer. The homogenization decreases the fat globules to three to four microns whereas when the fat is blended, the globule size will be 10 to 20 microns. By lowering the globule size and adding the emulsifying effect of soy lecithin, the digestibility of fat is greatly increased for the young calf.

Now that the various milk replacer ingredients have been discussed, we can classify various formulations of calf milk replacers. I choose to use

four classification: 1) Optimum, 2) Acceptable, 3) Passable, and 4) Inferior.

The optimum milk replacers would be those that contain only protein from milk. The protein level should be at least 20%. The NRC suggests a protein level of 22%. There is enough research evidence and field experience to indicate that 20% protein is sufficient when all of the protein is derived from milk. The fat level should be at least 10% and may run as high as 20%. The higher fat level has an advantage in that it tends to lessen diarrheal problems when they occur and because the higher fat level tends to be costive. All of the ingredients in a milk replacer in the optimum range must be of top quality.

The milk replacers in the acceptable range differ from those in the optimum in that a portion of the protein may be derived from the specially manufactured soy flours or soy concentrates. Also, the protein level should be 22%. This is done because the protein digestibility may be somewhat lowered and the protein equivalent per unit of nitrogen is lower than that of milk. Along with good management and environmental conditions and healthy calves, such milk replacers will give reasonably good performance, although not as good as when the optimum milk replacer is used.

The passable category is that group of milk replacers that has a portion of the protein provided by a non-milk source. And, this non-milk protein source does not necessarily have to be soy protein. Again, the protein level must be at least 22%, and the fat level must be at least 10%. Another difference is that the milk ingredients are of unknown quality. With all conditions excellent, with a product of this type, a dairyman may be able to keep a calf alive until the calf can exist on dry feed, but results will be unsatisfactory. The passable milk replacer cannot be recommended.

The last category is the inferior milk replacers. These are the milk replacers that do not fit in any of the previous categories. These products may be described as having the "license to kill" and should not be used under any circumstances.

In summarizing the use of calf milk replacers, advise your clients to purchase milk replacer by quality as outlined rather than price. Also, advise clients to follow the manufacturer's feeding directions so that they are properly used to bring about better results.

Calf Starters

As emphasis has been more and more toward early weaning, more attention must be focused on the calf starter. The calf starter must not only be

nutritionally sound, but it must also be very palatable. Thus, early consumption of calf starter can be realized. The calf starter should contain 16% protein, all from natural sources. Urea cannot be utilized until full ruminal development. When this occurs will vary on the type of diet fed. Calf starters that are composed of coarse grains and a pelleted supplement appear to be the most appealing to the calf. If the calf is introduced to dry feed early, full ruminal development can occur at six to eight weeks of age. Calf starter should be introduced by the end of the first week for maximum ruminal development and use of early weaning technique. Care should be taken that the calf starter always be fresh so that it is attractive to the calf.

Hay and Silage

Hay may be introduced by the second week. However, introduction of hay at this time is not mandatory. When early weaning is practiced and calves are kept in individual stalls or pens, hay feeding may be inconvenient. In these cases it is not necessary to introduce hay until following weaning and calves are in group situations. The hay used should be of the best quality available.

Silage is not recommended until the calf is at least two months of age. The younger calf, because of limited rumen capacity, will not consume enough nutrients for optimal performance. The silage, when used for calves, should be of top quality.

Use of Antibiotics

The reasons for use of antibiotics in the ration in calf rearing are two; one, the control of potential pathogens, and two, to effect an increase in food intake and utilization. With ideal management and facilities, the routine use of antibiotics in calf raising should be unnecessary and should be restricted to those occasions when it is found necessary. Ideal conditions are farms where colostrum intake is adequate, facilities are well ventilated, and density of calves is low and the calf raiser is experienced. However, the existence of this combination of factors is rare. Routine use of high levels of antibiotics in the diet for lengthy periods of time should be avoided. When high levels of antibiotics are used for lengthy periods, resistant strains of bacteria can be developed. It is desirable to keep antibiotic levels in the diet at low levels, or none at all, so that when disease strikes, the proper treatment procedure can be initiated and be more effective.

In the recent Michigan Calf Mortality Study, the results showed higher mortality when antibiotics

were routinely used prophylactically. This would indicate that they were probably being used as a crutch.

Summary

Because the calf is born with a digestive system that functions in its own peculiar monogastric manner, its nutritional demands are very particular. Whole milk is the most ideal feed, but because of economics, substitute diets must be considered. Colostrum and quality milk replacers may be used. Milk proteins are the most efficient and available

to the calf. Other sources of proteins have been used with varying degrees of success, with only specially manufactured soy proteins approaching milk proteins in performance. Animal fats have been successfully used to replace butterfat. Their utilization is enhanced by homogenization and addition of soy lecithin. Calf starters should not only be properly formulated, but also must be palatable. Hay and silage used should be of top quality. Routine use of antibiotics for calves should be avoided.

A Successful Program for Raising Dairy Calves

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Our operation has been written up in the Des Moines *Register* and they said that we're the largest cattle feedlot in the state of Iowa. I think probably some of those old Hereford and Angus boys would take exception to that. Our operation has been in business for three years and we are raising and marketing Holstein calves. We start with them from about three days of age and take them on to market. Because of the nature of our operation, we start with the baby calf and take it through and have it custom slaughtered and put a pampered beef label on it and the meat is sold over the counter as "pampered beef." We have a unit in Wisconsin at the present time with 3,500 baby calves. My younger brother runs that operation. We have 12,000 Holsteins in our feedlot. We have just completed a feedlot in Missouri that will be a 6,000-head Holstein operation. This is again from birth to market. We are under construction with a unit in Ohio that will produce a thousand calves per month. I have been asked quite a few times by visitors, and they are obviously city visitors who decide to get rich in the cattle business, how we keep the Holstein calves alive? Well, one day I was a little bit frustrated; it had been a long day and these people came driving in, in their shiny big cars, so my answer to them was that well, you set out and you dig this big trench about 600 feet long, about 20 feet wide and about six feet deep. When you fill that with dead calves then you are an

expert and know how to raise them! Well, I think I have probably filled my trench with dead calves so maybe I qualify to speak here this afternoon!

Our death loss at the present time in the operation in Wisconsin from purchase to weaning is running about six and seven percent. Our death loss in our Iowa feedlot is running about two percent. This gives you an average death loss from birth to market of about eight and nine percent.

I want you to bear with me and pretend you are a bawling 110-lb. Holstein calf coming through the front door, and we will take off from there!

We have two order buyers that buy our 350 calves a week that we start in Wisconsin. We buy these from Wisconsin and Minnesota. We have one requirement—that the calves be delivered the same day that they are purchased. A lot of the calves we buy are bought by the pound; we want the calves to have dry navels and be a minimum of 100 lbs. when they arrive. We try to buy calves that are three days of age or older to be sure they have had colostrum. I do not think we have had this problem that Dean was speaking of in small calves, if they have had colostrum. The type of calves that we buy are fresh and bellowing. Our calves average 115 lbs. coming in. We try to buy good-boned calves. We check every navel to make sure there is no swelling. We want a healthy look and a shiny hair coat. We have the right to reject calves for 24 hours after they come into our facility from our