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Dairy Guidelines

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Relative Values of Alternative Feeds

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Shelled corn and soybean meal are the standards for energy and protein, respectively, against which other feeds are usually priced. When corn and soybean meal prices are high, alternatives are many times attractive. Decisions for use of alternative feeds should be based on the ability to reduce ration cost. Some feeds do have unique characteristics that might warrant use under certain conditions, even though ration cost is increased. This is especially true of certain by-product feeds.

Table 1 contains nutrient analyses for several feeds commonly available in Virginia. The table includes high-energy feeds, by-product feeds, and protein supplements. Some fit into more than one category. The high-energy feeds contain 83% TDN (0.87 Mcal of net energy per lb of dry matter) or greater, but are relatively low in protein (14% or less). The by-product feeds vary considerably in energy, ranging from 62% TDN for alfalfa pellets to 98% for whole cottonseeds. Protein also varies greatly from 12% for hominy and soybean hulls to 30% for distillers grains. All of the by-product feeds are high in fiber relative to the high-energy feeds. The protein supplements contain 45% protein or greater and are fairly good sources of TDN, except urea. Urea is a source of non-protein nitrogen and does not contain energy, fiber, or minerals.

High Energy Feeds

Barley and wheat are feeds commonly available as substitutes for corn. Table 2 contains equations that can be used to estimate relative value of energy and protein content using shelled corn and soybean meal (44%) as the standards. For instance, if corn is $140/ton and soybean meal is $280/ton, barley is worth $153/ton [(0.908 x 140) + (0.093 x 280)] based on energy and protein content. A bushel of barley weighs 48 lbs and would be worth $3.70/bu ($153/2000 = $0.077/lb x 48 lbs = $3.70). Often, when corn is expensive, barley is a good buy if available. Barley has less TDN (83 vs 88%) and more protein (13 vs 10%) than corn and can be used as a partial or total substitute. However, many dairymen prefer to include some corn along with barley in concentrate mixes.

Using the same procedure to calculate relative value of wheat (60 lb/bu), it would be worth $157.50/ton or $4.73/bu. Wheat should be limited in dairy rations. Usually 1 part wheat to 2 parts corn is satisfactory when concentrate is fed separately from silage. If feeding concentrate mixed with silage, a higher proportion of wheat can be used, but should not be greater than 1 part wheat to 1 part corn. Wheat is

most palatable if rolled or crimped, because grinding tends to turn wheat into a fine flour. The starch in wheat is fermented more rapidly than the starch in corn, and rumen acidosis (excessive acid production) can result if large quantities of wheat are fed over a short period of time.

By-product Feeds

There are several by-product feeds that can be used in dairy rations. Several have unique characteristics that make them attractive. By-product feeds are not as consistent in nutritive value as commercial concentrates, and care should be taken to evaluate them before buying. A book value may not be adequate; a laboratory test will give a better indication of nutrient content.

Hominy feed, a by-product of corn milling, has been shown to be approximately equal to shelled corn as an energy source for dairy cattle, and it contains slightly more TDN and protein. Substitution for corn is possible, but the amount should be limited to a maximum of 50% of the concentrate mix if concentrate is fed separate from forage.

Soybean hulls are a unique feed because they are high in fiber (46%) and energy (78% TDN). Most feeds high in fiber are low in energy. The fiber in soybean hulls is readily digestible compared to fiber found in forages. Generally, limit soybean hulls to a maximum of 0.4 lbs per 100 lbs of body weight, or 20% of the concentrate, because this fiber does not stimulate cud chewing or salivation as well as forage fiber.

Alfalfa pellets are not a by-product feed but have many similarities. Due to the physical form of the pellets, the fiber is not "effective" in stimulating salivation and, thus, maintaining milk fat percent. Alfalfa pellets behave more like a concentrate than a forage. The protein in alfalfa pellets is very undegradable in a cow's rumen, indicating a high "by-pass" type of protein. Research has demonstrated a benefit of "by-pass" protein for lactating dairy cows under certain conditions. When using alfalfa pellets, limit them to 0.4 lbs per 100 lbs of body weight and make certain that adequate amounts of other forages are fed.

Wheat middlings are a by-product of wheat processing. A standard analysis would be 19% protein, 11% acid detergent fiber, and 80% TDN. Therefore, middlings are a relatively good source of both protein and energy. Wheat middlings can be included in a concentrate to a maximum of 25% of the mix. If feeding mixed with silage, limit wheat middlings to approximately 0.4 lbs per 100 lbs of body weight.

Whole cottonseeds (24% protein and 98% TDN) have increased in popularity because of reported increases in milk fat percent when fed. This response, however, has been inconsistent. Cottonseeds are usually cheapest in the fall at harvest and get progressively more expensive until the next harvest. Whole cottonseeds are a unique by-product feed high in fiber (29%) and energy (98% TDN). Undelinted cottonseeds can be used to extend forage, but should not be used in a dairy ration at greater than 0.5 lbs per 100 lbs of body weight. Since cottonseeds are high in fat, greater amounts can reduce fiber digestion and mineral absorption. For high producing cows consuming whole cottonseeds, calcium should be 0.9 to 1.0% of ration dry matter and magnesium should be 0.25%.

Dry brewers grains and distillers grains are relatively high in fiber and will extend or substitute for some of the forage in a ration. However, the "effectiveness" of this fiber is not what a normal forage would be. These by-product feeds are good sources of

"by-pass" protein. However, care should be taken to prevent excessive amounts of these feeds in rations because palatability can be reduced. Dry brewers and distillers grains should be limited to 0.6 lbs per 100 lbs body weight or 25% of the concentrate mix.

Wet brewers grains are very similar to dry brewers grains from a nutrient standpoint. Like dry grains, wet grains can extend or substitute for some of the forage in a ration. Also, wet brewers grains are a good source of "by-pass" protein and can increase ration palatability when corn silage is extremely dry (greater than 45% dry matter). It is best to mix brewers grains with silage for feeding. Since this is a wet feed, storage is sometimes a problem. Generally, a load should be fed within 10 to 14 days during the summer and by 21 days during the winter. Limit wet brewers grains to 2.5 lbs per 100 lbs body weight. Greater amounts will reduce feed consumption. Also, wet brewers grains should not be used (or at least limited) when silage is extremely wet (less than 32% dry matter).

Maltlage is a commercially prepared feed containing wet brewers grains, shelled corn, soybean meal, minerals, and vitamins. Maltlage (48% dry matter) contains 22% protein, 78% TDN, 12% acid detergent fiber, 1.2% calcium, and 0.7% phosphorus on a dry basis. Maltlage is easier to store than wet brewers grains because of the added starch from corn, which can be fermented like silage to end up with a stable product. Limit maltlage to 1.8 lbs per 100 lbs body weight.

Protein Supplements

Cottonseed and peanut meals are concentrated protein sources similar to soybean meal in quality. These protein sources can be used interchangeably with little problem, except occasional palatability differences when switching suddenly from one to another. Gradual adaptation is the best way to change ration ingredients.

Urea can be used as a partial substitute for some of the ration protein. Do not feed lactating cows over 1/2 lb/cow/day or include in the concentrate at greater than 1.5% (30 lbs/ton). Another rule of thumb is to limit crude protein from urea to 20% of the total ration protein. Urea can be fed to lactating cows, but caution must be taken to insure adequate natural protein (soybean meal, peanut meal, alfalfa, etc) in the ration. Urea should not be fed with other sources of non-protein nitrogen, such as anhydrous-ammonia-treated corn silage.

Conclusion

Using the equations in Table 2, the relative values of feedstuffs will change with corn and soybean meal prices. Remember to compare equivalent prices. If the price of one includes delivery, all should be on this basis. Also, if substantial wastage occurs during storage or feeding, this should be considered. Waste might be a problem with wet brewers grains. The equations presented can give an idea when an alternative feed is reasonable in price. However, variation in nutrient content can be a problem, especially for by-product feeds, because the equations were developed using book or average analytical results. We have a computer program available, called DAIR3, that can determine relative values for feeds and balance a least-cost ration. When several feeds are available, using this program is a better alternative.

Table 1. Nutrient Analysis for Selected Feeds*

	Dry Matter (%)	Crude Protein	Acid Detergent Fiber	TDN	Net Energy (Mcal/lb)	Calcium	Phosphorus
		---------% dry matter---------				-----% dry matter------	
High Energy Feeds							
Shelled corn	89	10	3	88	0.92	0.04	0.27
Barley	89	13	7	83	0.87	0.06	0.37
Wheat	89	14	4	88	0.92	0.06	0.37
By-product Feeds							
Hominy feed	91	12	12	92	0.97	0.06	0.58
Soybean hulls	91	12	46	78	0.87	0.45	0.17
Alfalfa pellets (17%)	93	20	35	62	0.64	1.54	0.28
Wheat middlings	90	19	11	80	0.84	0.12	1.01
Whole cottonseed	93	24	29	98	1.04	0.15	0.73
Dry brewers grains	92	26	23	66	0.68	0.40	0.68
Wet brewers grains	24	26	23	67	0.69	0.31	0.58
Dry distillers grains	92	30	16	88	0.92	0.16	0.79
Protein Supplements							
Cottonseed meal (41%)	93	45	20	75	0.78	0.17	1.31
Peanut meal (45%)	92	54	15	77	0.80	0.22	0.84
Soybean meal (44%)	89	50	10	81	0.85	0.35	0.69
Urea	98	281	0	0	0	0	0

*Taken from NRC (1978) and Virginia Tech Forage Testing Lab

Table 2. Equations for price comparisons of alternatives to shelled corn and soybean meal (44%)

Barley[a] ($/ton)	=	(0.908	x	corn $/ton)	+	(0.093	x soybean meal $/ton)
Wheat[a] ($/ton)	=	(0.875	x	corn $/ton)	+	(0.125	x soybean meal $/ton)
Hominy feed ($/ton)	=	(1.043	x	corn $/ton)	+	(0.012	x soybean meal $/ton)
Soybean hulls ($/ton)	=	(0.081	x	corn $/ton)	+	(0.175	x soybean meal $/ton)
Alfalfa pellets ($/ton)	=	(0.325	x	corn $/ton)	+	(0.241	x soybean meal $/ton)
Wheat middlings ($/ton)	=	(0.683	x	corn $/ton)	+	(0.258	x soybean meal $/ton)
Whole cottonseed ($/ton)	=	(0.656	x	corn $/ton)	+	(0.303	x soybean meal $/ton)
Dry brewers grains ($/ton)	=	(0.374	x	corn $/ton)	+	(0.464	x soybean meal $/ton)
Wet brewers grains ($/ton)	=	(0.121	x	corn $/ton)	+	(0.081	x soybean meal $/ton)
Dry corn distillers grains ($/ton)	=	(0.701	x	corn $/ton)	+	(0.35	x soybean meal $/ton)
Cottonseed meal, 41% ($/ton)	=	(0.025	x	corn $/ton)	+	(0.77	x soybean meal $/ton)
Peanut meal, 45% ($/ton)	=	(0.087	x	corn $/ton)	+	(0.996	x soybean meal $/ton)

Source: Morrison's FEEDS AND FEEDING

[a] Barley = 48 lb/bu, wheat = 60 lb/bu, shelled corn = 56 lb/bu