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Use of By-products in Growing Dairy Heifer Diets

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The goals of a heifer-feeding program are to reach a target freshening weight by 24 months of age or less, to improve feed efficiency and reduce costs, and to do this while allowing the animals to express their full genetic potential for milk production.

Feed costs remain the single largest expense in raising dairy heifers; therefore, a feed cost reduction that does not sacrifice production improves net income. Feed costs may be reduced by the use of locally available by-product feeds. Nutritional composition of by-product feeds, however, may vary from the animal's nutritional requirements, making the incorporation of such feeds into the diets challenging.

Growth and nutrient requirements of growing heifers

When rearing dairy heifers, one must be cautious of excessive weight gains, which result in over-condition. The National Research Council's Nutrient Requirement for Dairy Cattle (NRC, 2001) recommends that heifers gain on average 1.9 lbs per day to attain recommended size at calving at 23 to 24 months of age. Excessive weight gains result in fat deposits in the udder. This reduces milk production in subsequent lactations, and it increases calving difficulty and metabolic disorders. Energy fed in excess of requirements has the greatest impact on body condition. Monitoring growth is thus very important when establishing a feeding program for replacement heifers (Table 1).

Varying the nutrient density of the diet regulates growth and weight gain. The inclusion of highly digestible feeds in balanced diets results in more energy available to accelerate growth. A diet that seems adequately balanced "on paper" may result in decreased weight gains if bunk space is limited. High energy feeds need to be balanced with low-energy feeds. In over-conditioned heifers, dietary energy needs to be limited, either by restricting the amount of feed offered or by adding low-energy feeds such as crop residues (straw and corn stalks) to the diet. Poor quality forages with a high neutral detergent fiber (NDF) fraction of low digestibility usually limit intake due to their "fill effect." These forages can be incorporated into diets to limit total intake.

When balancing diets, it is important to consider not only the amount of grain or starch included in the diet but also the quality of the roughage supplied. Fiber digestibility varies across different feedstuffs. Feeds high in fiber can supply variable energy depending on their digestibility. For some by-products (e.g. distillers grains), a significant portion of the energy supplied comes from fat content.

Nutrient composition of by-products

Table 2 shows the nutrient composition of some traditional and by-product feeds commonly used in heifer diets. Not all feeds that have higher fiber content are necessarily lower in energy. Corn silage, for example, has an energy content comparable to that of soy hulls even though soy hulls have 33% more NDF. On the other hand, feeds like straws and corn stalks are high in NDF and, as expected, low in total digestible nutrients (TDN). The protein content of high fiber feeds is in general medium to low. One exception to this "rule" is distillers grains, which have an NDF content of close to 40% and a protein concentration of approximately 30%. This results from the fermentation of starch in corn to ethanol and the subsequent three-fold concentration of all other nutrients (protein, fat, and minerals).

Using by-products to balance high fiber diets

By-products are excellent feeds to use in heifer diets. Their nutrient profile can make them complementary of the deficiencies observed in some roughages. Protein and energy are costly nutrients that can be supplied by some of these by-products.

Distillers grains (DG), for example, are recognized as an excellent source of protein and energy for ruminants, although there is little information about incorporating them into the diets of growing dairy heifers. Optimal average daily gains of replacement dairy heifers should

be 1.9 lbs per day and not greater to ensure body size and mammary development for a high producing dairy cow.

Data from experiments conducted on growing beef cattle may be extrapolated–with caution–to growing dairy heifers. Growing beef calves fed either wet or dried DG demonstrated no differences in rate of gain or protein accretion. Rate of gain increased and feed efficiency (pounds of feed required per pound of gain) improved, regardless of moisture content, when 40% of diet dry matter from either wet DG (WDG) or dried DG (DDG) with solubles replaced dried rolled corn in the diets of cattle.

Cattle fed WDG, however, had higher feed efficiency compared with those fed DDG. Varying concentrations of heat-damaged protein in DDG with solubles–a potential problem with lactating dairy cows–did not affect performance of these growing cattle, because they were consuming protein in excess of requirements. This research indicated that for growing ruminants, DG fed at 40% of diet dry matter contain greater net energy for gain (NEg) than dried rolled corn, and the wet product contains greater NEg than dried DG.

Blending WDG with soy hulls

Recent research at South Dakota State University indicates that palatability of heifer diets containing WDG is exceptional. Growth of dairy heifers was evaluated when the heifers were fed diets of WDG ensiled with soy hulls. Heifers with an average weight of 400 lbs. were fed either a traditional heifer diet containing bromegrass hay, corn, soybean meal, and a mineral/vitamin pack; a second diet with the inclusion of 24.4% of WDG ensiled with soy hulls; and a third diet where the same ratio of WDG ensiled with soybean hulls constituted 48.7% of the dry matter.

The diets provided similar energy and protein concentration (DM basis) at 0.46 Mcal NEg/lb and 16.0% protein; however, percentages of acid detergent fiber (ADF) and NDF increased as WDG ensiled with soy hulls increased in the diets. In this experiment, average daily gain (2.73, 2.73, and 2.79 lb/d) did not differ when the amount of WDG ensiled with soy hulls was increased in the diet. Growth characteristics such as heart girth, body length, and hip height were similar regardless of diet; however, heifers fed the diets that contained WDG ensiled with soy hulls tended to increase in wither height (1.4, 1.9, and 1.9 in/month).

Blending WDG with corn stalks

Since WDG provide more protein, fat, and phosphorus than what is required by growing dairy heifers, a good match to feed with DG are low quality, high fiber feeds such as crop residues. Corn stalks or small grain straws thus make excellent alternatives to explore. Wet DG alone provide too much protein, fat, and phosphorus (Table 2) whereas corn stalks do not provide enough. When blended together at adequate levels, these feeds can provide recommended nutrient concentrations.

Researchers at SDSU fed a WDG-corn stalk blend to evaluate growth characteristics of dairy heifers compared to heifers fed a traditional heifer diet. Heifers were fed either a traditional diet consisting of alfalfa and grass hays, alfalfa haylage, corn silage, DDG, earlage, and a mineral/vitamin pack, or a second diet that consisted of 86% of a blend of 69% WDG ensiled with 31% corn stalks, rye straw, minerals, and vitamins. Both diets were formulated for similar nutrient concentrations on a dry matter basis of 0.41 Mcal NEg/lb, 18.6% protein, 25% ADF, and 37% NDF.

Fat was higher in the treatment diet (10.5%) than the control diet (5.1%) resulting from unusually high fat concentration (20%) in the WDG. In spite of this difference, heifers fed the traditional diet gained more weight than those fed the diet formulated with the WDG/corn stalks blend (2.82 vs. 2.31 lb/d); however, both were greater than recommended by the NRC. The results of this trial suggest corn stalks and WDG can be incorporated successfully in heifer diets without negatively affecting growth.

Economics of feeding WDG

In this research, including WDG and other by-products decreased the cost of dairy heifer diets. In the WDG-soy hulls experiment, the average daily cost of feeding the heifers decreased from $0.81/d to $0.68/d to $0.52/d for heifers fed the control, low DG-soy hulls, and high DG-soy hulls diets, respectively. In the WDG-corn stalks experiment the average daily cost of feeding the heifers decreased from $0.86/d for heifers fed the control diet to $0.52/d for heifers fed the WDG-corn stalks diet. It should be noted that these values will fluctuate with market prices, but it does illustrate that utilizing low-cost, alternative feeds can potentially decrease costs without sacrificing heifer growth.

Conclusion

When heifers are fed high-energy diets free choice, they will gain more weight than currently recommended. Heifers may need to be restricted-fed in order to meet the targeted average daily gain. Alternatively, high roughage, low-energy diets fed free choice may be a low-cost alternative when compared to high-energy diets. High roughage diets fed free choice are self-restricting as a result of rumen fill, although they can still be able to meet nutrient requirements if adequately balanced.

References

Ham, G. A., R. A. Stock, T. J. Klopfenstein, E. M. Larson, D. H. Shain, and R. P. Huffman. 1994. "Wet corn distillers byproducts compared with dried corn distillers grains with solubles as a source of protein and energy for ruminants." *J. Anim. Sci.* 72:3246-3257.

Hoffman, P. C. 1997. "Optimum body size of Holstein replacement heifers." *J. Anim. Sci.* 75:836–845.

Kalscheur, K. F., A. D. Garcia, A. R. Hippen, D. J. Schingoethe. 2004. "Growth of dairy heifers fed wet corn distillers grains ensiled with other feeds." *J. Dairy Sci.* 87 (Suppl. 1).

Table 1. Recommendations for growth characteristics of large-sized Holstein heifers

Age	Body weight (lbs)	Wither height (inches)	Hip height (calculated)	Body length (inches)	Condition score
0	93	30.0	31.6	32	2.0
1	139	32.0	33.7	34	2.1
2	185	34.0	35.8	37	2.1
3	242	36.5	38.4	39	2.2
4	298	39.0	41.1	41	2.3
5	355	40.0	42.1	43	2.3
6	410	41.5	43.7	46	2.4
7	467	43.0	45.3	48	2.4
8	522	44.0	46.3	50	2.5
9	580	45.0	47.4	52	2.6
10	635	46.0	48.4	53	2.6
11	692	46.5	49.0	55	2.7
12	747	47.0	49.5	56	2.8
13	804	48.0	50.6	58	2.8
14	860	49.0	51.6	59	2.9
15	917	50.0	52.7	61	2.9
16	972	50.5	53.2	62	3.0
17	1029	51.0	53.7	63	3.1
18	1084	52.0	54.8	64	3.1
19	1142	52.5	55.3	65	3.2
20	1197	53.0	55.8	65	3.3
21	1254	54.0	56.9	66	3.3
22	1309	54.5	57.4	67	3.4
23	1366	55.0	57.9	67	3.4
24	1422	56.0	59.0	68	3.5

Source: P.C. Hoffman, 1997.

Table 2. Nutrient content of selected feeds[1]

	Nutrient Content (% DM)							
Feed	CP	ADF	NDF	Fat	TDN	Ca	P	S
Distillers grains	29.7	19.7	38.8	10.0	79.5	0.22	0.83	0.44
Corn grain, ground	9.4	3.4	9.5	4.2	88.7	0.04	0.30	0.10
Soy hulls	13.9	44.6	60.3	2.7	67.3	0.63	0.17	0.12
Beet pulp	10.0	23.1	45.8	1.1	69.1	0.91	0.09	0.30
Corn silage	8.8	28.1	45.0	3.2	68.8	0.28	0.26	0.14
Corn stalks	5.4	46.5	77.0	1.1	54.1	0.35	0.16	0.10
Oat straw	4.4	47.0	70.0	2.2	50.0	0.24	0.06	0.23
Wheat straw	4.8	49.4	73.0	1.6	47.5	0.31	0.10	0.11
Alfalfa hay, mature	17.2	41.5	53.6	1.7	53.9	1.09	0.28	0.26
Grass legume mix, mature	13.3	42.1	62.5	2.3	57.0	0.73	0.27	0.29

Source: NRC (2001).

[1]These values can vary. Analysis of by-products is recommended prior to incorporating into diets.

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