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Protein, Fiber, and Digestibility of Selected Alternative Crops for Beef Cattle

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Summary

Field peas, dry edible beans, pumpkins, chicory, beets, and beet pulp grown in western Nebraska were analyzed for their salvage value in beef cattle diets when they do not meet specifications for human consumption. The digestibilities of all the crops were high (61-88%). Beet pulp, beet root, and chicory root were low in CP (< 7%) while all other crops were greater than 9%. Neutral and acid detergent fiber were ≤ 50%. Lectins in raw dry edible beans force them to be limited to < 2% of diet DM. Palatability of chicory root can reduce intake.

Introduction

Several unique crops are grown in western Nebraska primarily for human consumption. However, weather conditions, markets, or other factors may cause them to be unsuitable for human consumption and alternative uses or a salvage value is required for the crop. Livestock feeding is often a logical solution for crops deemed unacceptable for human consumption. More specifically, since beef production accounts for approximately 50% of western Nebraska's economy, the value of these crops for cattle feeding becomes important. This information could be used to determine how to include these crops in beef cattle rations should the opportunity arise. Crops selected for analysis included field peas, dry edible beans, pumpkins, chicory, whole beets, and beet pulp.

Field Peas

Field peas are becoming increasingly popular in western Nebraska as an alternative to fallow in dryland wheat production rotations. As a legume, peas add nitrogen to the soil, and their early maturity date (July-August) complements fall wheat planting nicely.

Dry Edible Beans

Nebraska is one of the leading states in the nation in dry edible bean production. In particular, the North Platte River Valley is known for its consistently high quality bean production, and is responsible for over 85% of the Great Northern beans produced in the nation. Not all the beans produced are suitable for human consumption. Broken or discolored beans as well as frost damaged, diseased, or high moisture beans are available for livestock consumption. Typically, cull beans are used as a binder and protein source in range supplements for grazing cattle. Previous research has shown cull beans can be fed without adversely affecting performance up to 2% of diet DM. The adverse effects associated with feeding cull beans are thought to be due to proteins called lectins that interfere with protein digestion and cause watery diarrhea. Apparently the heat required for pelleting is insufficient to denature these proteins.

Pumpkins

Pumpkins are grown in western Nebraska for decorative purposes in the fall as well as for human consumption. Pumpkins with blemishes are typically discarded and many pumpkins are broken or damaged during harvest, making them unacceptable for market. Furthermore, after October 31, the market for decorative pumpkins plummets and many pumpkins are left to rot in the fields. Some producers have grazed pumpkin fields in conjunction with cornstalk fields, but little is known about the nutritive value of pumpkins for beef cattle.

Chicory

Chicory is grown primarily for its inulin content. Inulin is a fructose-based sweetener used as a flavoring for coffee or as a coffee substitute. Inulin also has been reported to improve intestinal health in humans. Additionally, the leaves can be added as greens in salads. Occasionally, chicory is available for livestock consumption. While chicory is commonly added to pet food diets, its use in livestock diets has been more limited.

Whole Sugarbeet Roots, Tops, and Beet Pulp

Nebraska is ranked 6th in U.S. sugarbeet production. The sugarbeet industry makes a substantial contribution to the western Nebraska economy. Occasionally however, environmental conditions prevent harvesting the beets prior to ground-freezing conditions and just as with chicory, questions arise concerning grazing unharvested fields of sugarbeets. Beet pulp is by definition a co-product of the sugar production industry. However, it is a readily available product approximately five months out of the year and can be stored for later use. It is consistently available whereas whole sugarbeets typically are not. Therefore, its value to the beef cattle industry warrants discussion.

Procedure

Field peas and dry edible beans were subsampled after the crops were harvested. Whole bean plants (black beans) were randomly selected from a test plot after it was determined the beans were not going to be acceptable for harvest. Pumpkins were randomly selected from a local producer's farm after October 31, when no more pumpkins would be sold from the field. Chicory and beets were randomly selected from

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Table 1. Nutrient content of field peas, pumpkins, sugarbeet pulp, dry beans, and chicory.

Item	DM	IVDMD[1]	CP	NDF	ADF
Field Peas	87.0	82.7	15.1	9.5	8.0
Carving Pumpkin	11.9	71.4	14.3	36.8	25.6
Pie Pumpkin	16.5	61.0	14.4	38.6	32.5
Sugarbeet Pulp	26.1	76.1	6.6	45.4	27.4
Whole Sugarbeet Root	23.8	86.8	3.3	15.4	6.7
Whole Sugarbeet Leaves	36.7	65.2	10.9	50.8	24.0
Black Beans	96.9	83.5	15.4	14.3	4.7
Great Northern Beans	98.2	88.0	15.0	7.2	3.7
Pinto Beans	98.3	84.6	14.5	12.0	5.9
Total bean plant (black beans) after frost	90.4	66.3	9.0	38.6	32.4
Chicory Roots	26.1	88.9	3.7	8.6	5.3
Chicory Leaves	17.6	67.3	8.5	23.6	21.4

[1]IVDMD values were adjusted based on the average of 5 *in vivo* forage standards.

the fields prior to harvest, while the beet pulp was subsampled from Western Sugar in Scottsbluff, Neb. as the beets were being processed. Dry matter was then determined on all crops in a 100°F oven for 48-72 hours. Samples were ground and analyzed in triplicate for CP, natural detergent fiber (NDF), and acid detergent fiber (ADF), and *in vitro* dry matter digestibility (IVDMD, similar to TDN). The IVDMD procedure included a 48-hour incubation in rumen fluid followed by a 24-hour pepsin digestion. Samples were analyzed with five forage samples of a known *in vivo* value. On average, the *in vitro* method overestimated the known forage samples 5%. Therefore, the test samples were adjusted 5% as well.

Results and Discussion

Field Peas

Previous research indicated field peas can be fed whole or processed with an optimum inclusion level of 20% DM. Field peas are highly digestible, high in CP, and low in fiber (Table 1). Previous research (*2010 Nebraska Beef Cattle Report*, pp. 107-108) indicated they are palatable, maintain performance, and enhance carcass tenderness.

Dry Edible Beans

Previously reported CP values for beans have ranged from 22-24% (DM basis). The analysis for this report only ranged from 14.5-16% (Table 1). Great Northern beans were lower in NDF and ADF than pintos or black beans while digestibility and CP were similar for all beans analyzed. Analysis was also conducted on whole bean plants after frost to determine the feeding value of the whole plant if it were to be baled rather than harvested at all. The CP was much lower and the NDF and ADF much higher (Table 1), but the high percentage of raw beans would still warrant feeding with caution.

Pumpkins

The analysis presented in Table 1 indicates DM digestibility and CP to be high (61-71% and 14.3% DM, respectively) and the fiber to be moderate (25-38% DM). Carving pumpkins tended to be lower in DM and ADF and have greater digestibility than pie pumpkins. CP and NDF were similar for both types of pumpkins. These data suggest pumpkins are a good source of energy and adequate in protein.

Chicory

Past research (1999 Nebraska Beef Report, pp. 37-39) has included the ground root in growing diets as a replacement for silage at <30% (DM basis). Results were comparable to using beet pulp to replace silage, but with lower intakes, probably due to the palatability of the chicory root. Average quality analysis for both roots and leaves of four varieties of chicory are presented in Table 1. The chicory root is high in DM digestibility, but very low in CP, NDF, and ADF. The leaves however, contain moderate DM digestibility, NDF, and ADF, and adequate CP. Typically, tops are destroyed and left in the field for organic matter at harvest and are not available to feed to cattle. Questions occasionally arise about grazing unharvested fields and therefore quality analysis of the tops would be meaningful; however, the risk of cattle choking on small uprooted chicory roots is an issue to be considered.

Whole Sugarbeet Roots, Tops, and Beet Pulp

Analyzed whole sugarbeet plants were similar in DM digestibility, CP, and ADF to whole chicory (Table 1). The NDF, however, was higher in whole sugarbeets. The removal of the sugar increases CP, NDF, and ADF content as compared to the whole root. However, beet pulp has a high IVDMD, moderate NDF and ADF with a fairly low CP value (Table 1). Therefore, it is typically included in growing calf rations at < 30% (dry matter basis). Additional research is currently being conducted on the use of beet pulp in gestating cow and feedlot finishing diets.

Implications

All crops analyzed in this study were highly digestible with low to moderate protein content and could be included in beef cattle diets to decrease ration costs.

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