Feeding Heifers and Steers Whole and Ground Barley

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Grain processing is synonymous with cattle feeding. Most processing methods have been developed to improve starch availability (Frederick et al., 1973). Toland (1976) observed the mean digestibility of barley was increased by dry rolling compared to feeding whole barley. The digestibility of roughages, however, is reduced when processed barley is included in forage-containing rations (Pontiainen et al., 1971; Valentine and Bartech, 1987).

Since much of the research involving processing barley was completed prior to the rise in fuel energy costs, the question arises if enough benefit is gained from processing to pay for the additional expense. May and Barker (1984) found it was profitable to mill barley when the unit value of the feed exceeds approximately twice the unit cost of milling the grain. Much of the previous research was done with relatively high levels of barley or with restricted intake of dry matter. The objective of this project was to compare the cost of gain for heifers and steers fed forage-based diets supplemented with whole or ground barley.

MATERIALS AND METHODS

Ninety-four beef calves were utilized in this study. One pen (10 steers and 37 heifers) was fed a growing diet containing whole barley. The second pen (nine steers and 38 heifers) was fed a growing diet containing ground barley. The cattle remained on feed for 98 days. The rations were identical in composition except for the processing method used on the barley (Table 1). The rations were balanced based on NRC (1984) requirements for 1.5 pounds per day gain.

Table 1. Diet for whole barley-ground barley trial.

Feedstuff	% of Ration (DM basis)
Barley	31.6
Alfalfa-grass hay	68.4

RESULTS AND DISCUSSION

Initial weights were similar at the beginning of the trial (Table 2). The heifers fed ground barley were 33 pounds heavier at the end of the trial than the heifers fed whole barley. The ground barley fed heifers gained 0.36 pounds more per day than the whole barley fed heifers.

Table 2. Animal performance for heifers fed whole or ground barley.

Treatment	Initial Weight (lbs)	Final Weight (lbs)	ADG (lbs)
Pen average			
Whole barley	468	576	1.10
Ground barley	468	608	1.43
Heifer average			
Whole barley	479	575	0.98
Ground barley	476	608	1.34
Steer average			
Whole barley	428	579	1.54
Ground barley	435	608	1.77

The economic returns of processing barley were compared at three price levels for processing. Processing charges would have to reach a price of $37 per ton to make feeding whole barley economically feasible. The breakeven for processing will vary with level of barley in a particular diet.

Table 3. The cost of grain per pen at three price levels for barley processing.

Processing Cost	Barley Intake (lbs)	Hay Intake (lbs)	Feed Cost: Barley Cost ($)	Feed Cost: Hay Cost ($)	Cost of Gain ($/lb.)
Whole barley					
$ 0	20,740	58,375	559.98[1]	875.63[2]	0.28
Ground barley					
$ 5	20,752	59,575	612.18	893.63	0.23
$10	20,752	59,575	664.06	893.63	0.24
$15	20,752	59,575	715.94	893.63	0.25

[1]Barley $54 per ton

[2]Hay $30 per ton

SUMMARY

Ninety-four beef calves were utilized in a study to evaluate the economic value of processing barley in growing rations. Calves fed processed barley were heavier (32 pounds) and had a more rapid daily rate of gain (0.33 pounds). Cost of gain was also cheaper for calves fed processed barley.

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Continued from page 2

video camera and a computer system that acts as an image processor and system controller. A machine vision system can detect defects or sort for size or shape of objects on processing lines.

The U.S. Air Force has a global positioning system partially operational at the present time. Twenty-one satellites will be placed into orbit to complete a basic navigational system. The system provides for accurate location of sites on earth and is being used as a tool for ground surveying. This system, coupled with automatic guidance and variable rate planters and fertilizer applicators, can make possible the optimization of plant populations.

Transmission of electronic signals through the air using infrared light beams is being used in engineered systems. Data collected from sensors can be transmitted more easily from the field using infrared than if the wire is used. An example of this technology is the use of infrared light beams to transmit signals from soil moisture sensors to computers for automated irrigation systems.

Lasers are in use today for controlling land leveling equipment. The equipment is used in the Red River Valley. In this application, the laser is part of the sensor system. The beam is used to indicate if a receiver is above or below a predetermined elevation. In response, the leveling control equipment is activated.

Water balance irrigation scheduling methods, developed in North Dakota, are being adapted to automating irrigation management to make more efficient use of irrigation water possible. These management systems will use data that are transmitted from sensing units in the field to a computer located at the farmstead. Data analyzed by the computer in turn will be transmitted back to the irrigation system to start and stop the unit automatically.

Upgrading food products, developing agricultural based industrial feedstocks, and biotechnology all can be used to develop new uses of crops. Agricultural engineers will design, test, and supervise fabrication of equipment needed to commercialize processes developed by biological scientists.

The stomata of plants provide for movement of gases and water vapor through the plant leaf. Engineers have used computerized finite element analysis to understand and model the opening and closing of stomata. Control of these stomata based upon engineering analysis could affect drought resistance of crops.

A computer-controlled gantry operating over plots of land to carry out field operations from tillage to harvest is under test. Wheels at each end of the gantry run on tracks or compacted soil paths. Overhead trusses span the space between the wheels and are used to guide power units and implements. Greater precision in control of tillage, planting, and harvesting systems may be achieved with the system and soil compaction may be controlled.

Diesel engines with improved efficiency are under development and may be adapted to agricultural tractors. Today's engines utilize only about one-third of the heat energy of the fuel to produce work. The remainder is lost through exhaust gases and cooling system. New ceramic materials are being built into engines to make it possible to operate them at higher temperatures. These adiabatic diesel engines show significant promise of converting a major part of the heat energy of fuels into useful work.

Agricultural engineers are developing automated controls for combines. Several sensors including devices to measure grain loss from the sieves are in common use. Electronic signals from sensors of this kind are being sent to a computer which in turn can send signals for control of appropriate components of the combine. Ground speed, concave clearance and air flow rates are examples of components that can be controlled automatically.

Systems for utilizing on-board computers are being developed to optimize tractor performance. A series of sensors can be used to measure factors to allow computer control based on sensor input. Fuel efficiency is a major variable that may be controlled in this way, but the system could be adjusted for other factors such as maximum work rate in emergency situations.

Robots are being developed for a wide range of agricultural engineering applications. An example is a machine for transplanting plants from greenhouse flats to the field. Sensors are used to identify containers with viable plants.

The future holds potential for many exciting developments. Engineers at NDSU will contribute to these developments. They build on a program that dates back to 1892, two years after the North Dakota Agricultural College was established, when E.S. Keene was appointed Agricultural Engineer with the Agricultural Experiment Station. Research, teaching, and extension activities in agricultural engineering and agricultural mechanization technology have been a part of the university since. Most engineering developments cannot be attributed to single isolated research breakthroughs. Most developments have resulted from evolutionary changes. Researchers and alumni from the Agricultural Engineering Department at NDSU have contributed to these changes over the years. It's been an exciting period of development and shows promise of leading to a future where agricultural engineers will continue to develop equipment and facilities that will insure that North Dakota agriculture remains competitive in the world economy.