SHORT COMMUNICATION

Use of whole oat in feedlot diets

D. J. Gibb, Y. Wang, K. S. Schwartzkopf-Genswein, and T. A. McAllister.

Agriculture and Agri-Food Canada, Lethbridge Research Centre, P.O. Box 3000, Lethbridge, Alberta, Canada T1J 4B1 (e-mail: gibbd@agr.gc.ca). *Received 7 January 2009, accepted 2 April 2009.*

Gibb. D. J., Wang, Y., Schwarzkopf-Genswein, K. S. and McAllister, T. A. 2009. **Use of whole oat in feedlot diets.** Can. J. Anim. Sci. **89**. 415–417. Replacing 9% silage and 6% barley with 15% whole oat (DM basis) had inconsistent effects on DMI, but increased ($P<0.04$) eating rates and tended ($P<0.11$) to increase meal size in all diets. Oat reduced ($P<0.008$) gain/feed in the backgrounding diet, but increased gain/feed and ADG ($P=0.002$) in the 0% forage finishing diet. Dressing percent, but not carcass weight, was reduced by inclusion of oat in the diet. No difference in liver abscesses or animal health were observed.

Key words: Feedlot, forage, oat, eating behaviour

Gibb. D. J., Wang, Y., Schwarzkopf-Genswein, K. S. et McAllister, T. A. 2009. **Usage de l'avoine entière dans la ration des animaux d'élevage.** Can. J. Anim. Sci. **89**. 415–417. Remplacer 9% de l'ensilage et 6% de l'orge par 15% d'avoine entière (selon la quantité de matière sèche) a un effet variable sur l'ingestion de matière sèche, tout en accroissant ($P<0,04$) l'indice de consommation et en ayant tendance ($P<0,11$) à augmenter le volume des repas, peu importe la ration. L'avoine diminue ($P<0,008$) le ratio gain/aliment de la ration de semi-finition, mais hausse ce ratio et le gain quotidien moyen ($P=0,002$) de la ration de finition sans fourrages. L'addition d'avoine à la ration réduit les pertes au parage en pour cent, mais pas le poids de la carcasse. Les auteurs n'ont relevé aucune variation au niveau du nombre d'abcès ou de la santé des animaux.

Mots clés: Parc d'engraissement, fourrages, avoine, habitudes alimentaires

In beef feedlot production, feed efficiency is typically improved and cost per unit of gain decreased with increasing dietary energy levels. Due to the highly digestible starch they provide, grains are typically the cheapest source of energy and are therefore included at high levels (>80% of DM) in finishing diets. Grains are routinely transported by rail and/or truck across western Canada to meet the demands of the feedlot industry.

High dietary levels of rapidly fermented starch can compromise animal performance through digestive dysfunction, reduced intake, and/or poor animal health (Galyean and Rivera 2003). Forage is typically included at low levels (8–15% of DM) in finishing diets to maintain rumen health and animal performance. Besides the higher cost per unit of energy, forages provide other economic and handling challenges. For uniform mixing, forages must be chopped or ground to reduce particle size. Storage and interest costs increase the cost of feeding silage. Transporting chopped forage is expensive due to the low density of dry forage or the high water content of silage. Optimum forage levels in finishing diets have been investigated (Galyean and Defoor 2003; Stock et al. 1990). However, there have been few trials evaluating novel feeds that might simplify meeting fibre requirements and/or improve animal performance in the western Canadian feedlot industry.

Oat are a high-yielding source of grain, which can be easily transported and included in finishing diets. Due to their high fibre content [>29% NDF; National Research Council (NRC) 1996] and long kernel size, whole oat may provide roughage value in finishing diets. Research summarized by Owens et al. (1997) indicates energy value of oat grain may be higher than what is estimated by NRC (1996). Since this review, plant breeders have further enhanced the nutritional value by producing an oat that has a low-lignin hull with a high-fat groat (Zalinko et al. 2006). Oat has been evaluated as an energy source (Zalinko et al. 2006; Zinn 1993), but it is not known if whole oat can replace forage in finishing diets. If so, animal performance could be enhanced through increased dietary energy levels, while reducing forage costs and enhancing market demand for oat. A feeding trial was conducted to investigate the effect of replacing barley silage with whole oat on performance and feeding behaviour of feedlot cattle.

All cattle used in this study were cared for in accordance with guidelines set by the Canadian Council on Animal Care (1993). One hundred twenty steers

(353 ± 25 kg) were separated into two groups of 60 animals, with similar initial weight ($P = 0.90$) between groups. Each group of 60 animals was randomly assigned to one of six pens (10 animals per pen). Six of the pens were randomly chosen to receive typical feedlot diets containing temper-rolled barley and barley silage. Cattle in the other six pens received diets containing whole oat at 15% of the DM, which replaced 9% silage and 6% barley. All diets included 5% supplement (DM basis), which included trace minerals, vitamins, and monensin sodium to provide 33 mg kg^{-1}in diet DM. Barley was tempered to 20% moisture prior to rolling. Protein levels in the supplement of the diets containing oat were increased to maintain similar protein levels (>12.5%) between dietary treatments. Assuming 78, 65.5, and 84% TDN in oat, silage, and barley, respectively, 15% oat contained more energy (78% TDN) than 9% silage and 6% barley (72.9% TDN). Initially (days 1–63), growing diets were fed which contained 40% barley and 55% silage in the control diet. As 15% oat replaced 9% silage and 6% barley, this resulted in 34% barley, 15% oat, and 46% silage in the treatment diet. After the growing period, cattle were adapted to a finishing diet by sequentially reducing silage content using four transition diets over a 28-d period. The control finishing diet contained (DM basis) 86% barley, 5% supplement and 9% silage. The treatment finishing diet contained 80% barley, 15% oat and 5% supplement.

One of the five pens per treatment (10 animals per pen) was a GrowSafe pen (Basarab et al. 2003) that monitored daily intake, meals d^{-1}, meal size, and eating rate (g s^{-1}). Performance (DMI, ADG, gain/feed) and feeding behaviour was compared for days 1–63, days 64–119, and days 120–175. Measurements of performance and feeding behaviour were statistically analyzed as a completely randomized design using Proc Mixed analysis.

Oat samples ($n = 12$) contained 35.0 ± 2.9% NDF, 12.7 ± 0.60% CP, and 4.23 ± 0.43% oil compared with 14.9 ± 2.0% NDF, 13.3 ± 0.63% CP, and 1.62 ± 0.20% oil in the barley ($n = 12$). Oat has previously been documented to contain less (58.1% of DM) starch than barley (64.3%; Herrera-Saldana et al. 1990). From a random sample of 100 kernels, whole oat measured 1.1 ± 0.15 cm in length. Although whole oat displaced 9% of the barley silage (51% NDF), there were only minor differences in NDF levels between control and oat-based backgrounding (33.8 vs. 34.0%) and finishing diets (17.5 vs. 17.3%).

Displacing barley (6%) and silage (9%) with 15% oat during the backgrounding period increased DMI (8.94 vs. 8.39 kg d^{-1}; $P = 0.0001$), but not ADG (1.31 kg d^{-1}; $P = 0.48$) resulting in reduced gain:feed (0.147 vs. 0.160; $P = 0.008$). Increased DMI resulted from larger average meal size (982.6 vs. 671.2 g; $P = 0.03$) with steers consuming a similar ($P = 0.92$) number of meals per day (12.4) with both diets. Increased intake with reduced gain indicates cattle derived less energy from the oat-supplemented diet. Intake regulation of backgrounding diets is likely limited by physical capacity (Conrad et al. 1964). Replacement of silage with whole oat and rolled barley may have reduced digesta volume, thus facilitating higher intake. As well, higher silage levels in the control (55%) compared with the oat-supplemented diet (46%) may have resulted in a greater rate of passage and reduced digestibility, as discussed by Galyean and Defoor (2003).

Table 1. Effect of replacing 9% silage and 6% rolled barley with 15% whole oat on performance of calves fed barley-based diets

	Diet			
	Control	Oat[z]	SEM	$P =$
Initial weight (kg)	352.8	353.3	3.11	0.90
D 1–63				
DMI (kg d^{-1})	8.39	8.94	0.042	0.001
ADG (kg d^{-1})	1.32	1.30	0.0295	0.48
Gain:Feed	0.160	0.147	0.003	0.008
D 64–119				
DMI (kg d^{-1})	10.93	10.49	0.063	0.001
ADG (kg d^{-1})	2.0	1.96	0.042	0.51
Gain:Feed	0.183	0.187	0.004	0.42
D 120 –175				
DMI (kg d^{-1})	11.91	12.01	0.058	0.27
ADG (kg d^{-1})	1.73	1.90	0.036	0.002
Gain:Feed	0.145	0.158	0.003	0.003
D 1–175				
DMI (kg d^{-1})	10.22	10.31	0.049	0.21
ADG (kg d^{-1})	1.66	1.69	0.024	0.38
Gain:Feed	0.162	0.164	0.002	0.57
Final wt.	643.9	650.5	5.78	0.41

[z]In finishing diets, no silage was fed in the diet containing oat.

Table 2. Effect of replacing 9% silage and 6% barley with 15% whole oat on feeding behaviour of calves fed barley based diets

	Diet			
	Control	Oat[z]	SEM	$P =$
D 1–63				
Meals d^{-1}	12.3	12.5	0.47	0.92
Meal size (g)	671.2	982.6	38.8	0.03
Eating rate (g min^{-1})	55.9	84.4	3.19	0.02
D 64–119				
Meals d^{-1}	9.6	9.1	0.36	0.45
Meal size (g)	902.6	1168.6	43.3	0.05
Eating rate (g min^{-1})	80.5	110.5	2.3	0.01
D 120 –175				
Meals d^{-1}	8.6	7.9	0.27	0.23
Meal size (g)	1208.4	1454.7	61.7	0.11
Eating rate (g min^{-1})	124.2	156.7	4.6	0.04
D 1–175				
Meals d^{-1}	10.6	10.4	0.58	0.82
Meal size (g)	825.4	1106.2	45.77	0.05
Eating rate (g min^{-1})	73.6	102.5	2.38	0.01

[z]15% whole oat displaced 9% silage and 6% rolled barley. In finishing diets, no silage was fed in the diet containing oat.

The 28-d transition period made up one half of the subsequent period (days 64–119) that performance was measured. During this time, feeding oat reduced DMI (10.49 vs. 10.93 kg d^{-1}; $P = 0.0001$), but had no effect on ADG (1.98 kg d^{-1}; $P = 0.51$) or gain:feed (0.185; $P = 0.42$). Reduced DMI with no difference in ADG or gain:feed suggests increased energy availability on the oat diet. Larger average meal size (1168.6 vs. 902.6 g; $P = 0.05$) and faster eating rate (156.7 vs. 142.2 g min^{-1}; $P = 0.01$), of the higher-energy diet likely reduced ruminal pH contributing to reduced DMI (Fulton et al. 1979). Increased eating rates are associated with reduced time spent chewing (Defoor et al. 2002) and lower release of salivary buffers into the rumen. Although oat contain less starch than barley, once processed, rate and extent of ruminal starch digestion is actually faster for oat than barley (Herrera-Saldana et al. 1990).

From days 120 to 175, cattle received only a finishing diet. During this time, feeding oat increased eating rate (156.7 vs. 142.2 g min^{-1}; $P = 0.04$) without affecting DMI (11.96 kg d^{-1}; $P = 0.27$) or meal size (1336 g; $P = 0.11$). However, both ADG (1.90 vs. 1.73; $P = 0.002$) and gain:feed (0.158 vs. 0.145; $P = 0.003$) were improved when oat replaced silage in the finishing diet, indicating increased energy available to the animal for growth.

One of the primary purposes of roughage in finishing diets is to enhance energy intake through increased DMI (Defoor et al. 2002). Although oat did not stimulate DMI in this experiment, energy intake was increased as evident by increased ADG and gain:feed. The observation that DMI did not decrease with the inclusion of oat, despite increased energy concentration indicates oat may be an effective roughage source in finishing diets.

However, the increased eating rates and meal sizes may contribute to digestive disease. The low incidence of digestive disease (<2%; Galyean and Rivera 2003) makes detecting treatment differences in a research setting difficult. Similar rates of total (16.5%; $P = 0.50$) and severely abscessed livers (10.2%; $P = 0.95$) indicate digestive challenges may have been similar between diets. As well, there were no differences in animal health between treatments with only two animals on the control diet treated for respiratory disease.

Although dressing percent was reduced (58.1 vs. 58.7; $P = 0.03$) with the inclusion of oat, carcass weight was not affected (377.6 kg; $P = 0.61$) indicating that reduced dressing percent was a result of increased gut fill or organ weight resulting from the silage. Back fat (11.8 mm; $P = 0.69$), ribeye area (92.4 cm^2; $P = 0.27$) and quality grade (38.7% AAA; $P = 0.13$) were not affected by treatment diets.

Displacing all of the silage (9%) and 6% barley with 15% whole oat increased DMI and reduced gain:feed in backgrounding diets, but improved ADG and gain:feed (energy consumption) of cattle fed finishing diets without affecting DMI. Replacing silage with whole oat in finishing diets can reduce costs of storing, transporting, and processing forages, while making more land available for alternative crops. However, the implications of altered eating behaviour on animal health is uncertain. Further investigation is warranted, including an experiment that includes a negative control (0% oat or silage) to establish the true value of roughage sources, as well as documentation in large pen trials to monitor implications on animal health.

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