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In This Issue

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Ministry of Agriculture, Food
& Rural Affairs

Ontario

Using a rising plate meter as a tool to improve pasture management: Summer Project 2021

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Introduction

In Canada, grazing land, consisting of natural and planted pastures, accounts for approximately 50 million acres (Statistics Canada, 2011). Pastures provide numerous benefits to the producer, animals, and the surrounding environment. Grazing livestock on pasture provides economic benefits to the producer by supplying nutritious low-cost feed for livestock and utilizing marginal land not suitable for crop production (OMAFRA, 2015). Measuring and monitoring pasture growth on a regular basis can improve pasture performance, pasture productivity and livestock performance.

A rising plate meter is a tool that can assist producers in assessing the current state of their pastures, allowing them to make informed management decisions leading to better pasture and animal performance. The goal of this project was to demonstrate the effectiveness of measuring pasture using a rising plate meter at improving pasture management.

Materials and Methods

The primary site selected for this project was the Northwest Ranch at Victoria Community Pasture located in Hartley, ON. A secondary site, located in Nestleton ON, will be reported on later. The Northwest Ranch is 215 acres in size and is divided into eleven paddocks. The pasture was grazed by 110 heifers at a stocking rate of 0.51 animals per acre. Heifers consist of Angus, Simmental, Limousin, Charolais, and various crosses with an average weight of 625 lbs (284 kg). Heifers were turned out onto the Northwest Ranch for the 2021 grazing season in May and are still grazing this area. A rotational grazing system is implemented, with a rotation length of 32 days. The heifers have continuous access to an area know as the "swale" a low-lying area containing a water supply and access to minerals.

Measuring Pasture using a Rising Plate Meter

On a weekly basis, compressed sward heights were taken from each grazable area (P1, P2, P3, P4, P5, P6, P7, P8, P9, and P11) using a rising plate meter. A rising plate meter has a round plate that rises to a height based on the amount of forage beneath it and this height is used to estimate pasture quantity. As the rising plate meter is pressed down into the forage, it counts the number of notches the plate rises (each notch represents half a cm). The first step in sampling with the rising plate meter was recording the initial counter reading. Next, a zig-zag path was taken across each field, and samples were taken at each stride to provide an accurate representation of field conditions. After, the end counter reading and the number of samples were recorded. On average, 200 plate samples were taken per pasture. It's important to take as many plate samples as practically possible to achieve best representation of the state of the, i.e., areas with long and short grasses must be proportionally represented. Taking a high number of plate meter samples per pasture helps reduce the impact of operator error. In addition, it's important to follow the same rough track in each field each week where possible.

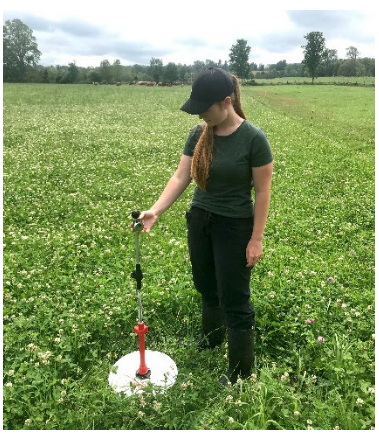

Figure 1: Using a Rising Plate Meter

Grass Sampling

On a monthly basis, pasture density (kg DM per ha cm) and dry matter (%) figures were determined. To calculate pasture density and dry matter content ten pasture samples were taken from a randomly selected field (P2). A diagonal path across the field to take grass samples was chosen, along which, ten grass samples were taken every 30-40 paces. At each sample point a quadrat (50cm X 50cm) was randomly placed from where the grass sample was to be taken. Prior to cutting the grass sample within the quadrat, a pre-clipping plate meter reading was taken. Using a grass shears, the grass contained within the quadrat was cut to approximately 3.5 cm. The cut grass was then gathered and placed into a labelled Ziploc bag. The bag containing the sample was compressed to remove as much air as possible, sealed, and placed into a bookbag. After cutting, a post-clipping plate meter reading was taken and recorded.

Laboratory
The wet weight of each individual grass sample, less the weight of the bag, was recorded. Next, the grass samples were combined, and a 100 g subsample was extracted. The subsample was then dried using a Koster Tester to remove all moisture from the grass allowing the dry weight to be determined. After 40 minutes of drying, the sample was weighed and returned to the Koster Tester to dry for an additional 20 minutes. After 20 minutes, the sample was re-weighed. The final dry weight was recorded when the weight change of the sample was less than 2g. If the weight change was more than 2g the sample was returned to the dryer.

Data analysis
Dry matter content of the pasture was calculated from the grass samples by dividing the weight of the dried subsample by the initial weight of the subsample x 100, (%). The kg DM per ha was calculated by taking the average weight of the quadrat samples, in kgs, x DM% x 40,000. From this pasture density, (Kg DM Ha cm), was calculated by taking the pasture dry matter content (kgs/ha) / (average pre-clipping compressed sward height – average post-clipping compressed sward height). Knowledge of pasture density is key to the effective use of the rising plate meter. Pasture dry matter content (kg DM per ha) was calculated on a weekly basis for each pasture by taking the average pre-grazing compressed sward height (cm) x pasture density (kgs DM per ha cm). Growth rates were calculated by taking the current week's pasture dry matter content (kg DM per ha) less previous week's pasture dry matter content (kg DM per ha) / 7. As pasture conditions change over time, pasture density and dry matter content (%) were recalibrated monthly.

From these calculations a pasture wedge was generated showing current, recommended, and future grazing conditions. A pasture wedge is a visual representation of pasture quantity (represented by the columns) and animal demand (represented by the line). Columns above the line indicate pastures that have surplus grass for their position in the rotation whereas, columns below the line indicate pastures that are deficient in grass for their position in the rotation. The current grazing pasture wedge (*figure* 2) displays the producers' original pasture rotation plan. The recommended grazing pasture wedge (*figure 3*) rearranges the pastures containing the highest dry matter content to the lowest.

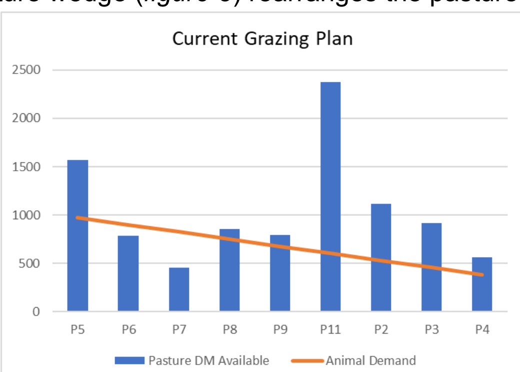

Figure 2: Pasture Wedge (Current Grazing Plan)

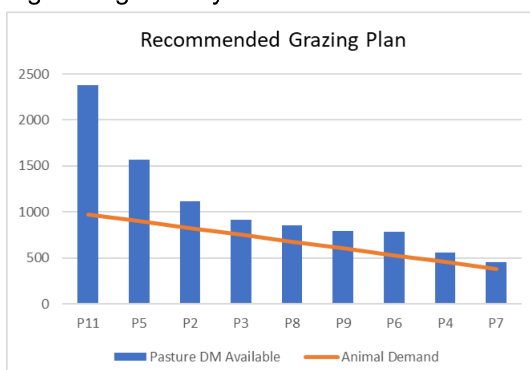

Figure 3: Pasture Wedge (Recommended Grazing Plan)

Rearranging the pastures to this new order, as shown in *Figure 3*, enabled pastures with an abundance of grass to be grazed first allowing slower-growing pastures to catch up. A predicted pasture wedge was also generated which showed what pastures could look like into the future based on the individual pasture growth rate. A pasture wedge is a powerful pasture management tool as it enables producers to easily see what pastures as performing well, which are not growing fast enough and in what is the order should pastures be grazed. Using a pasture wedge increases the control producers have over the grazing of their pastures ensuring livestock always have access to an adequate supply.

Results/Discussion
The research conducted over the summer demonstrated the usefulness of measuring and monitoring pastures. The average pasture growth rate from May 17th to August 25th at Victoria Community Pasture was 29.94 kg/DM per ha.

Table 1: Monthly changes in pasture DM%, pasture density and pasture growth rates

	Pasture DM (%)	Pasture Density (Kgs DM Ha cm)	Pasture Growth Rates (Kgs DM per Ha per Day)
May	31	178.51	68.41
June	37	154.66	29.46
July	31	191.93	23.67
August	36	272.29	36.84

As expected, pasture density fluctuated throughout the sampling period at Victoria Community Pasture. This is in line with observations from other Ontario locations that pasture density in Ontario is very farm specific. As an example, the secondary project location in Nestleton had a density figure of 228.03 (kg DM per ha cm) in May which was higher in comparison to the density determined at Victoria Community Pasture for the same month (178.51kg DM per ha cm).

The pasture dry matter content stayed relatively consistent throughout the grazing season. The total lbs of pasture dry matter produced throughout the grazing season are displayed in the graphs below (*Figures 4 and 5*). Pastures on the South end of the property (i.e., P2, P3, P4, and P11) produced a greater abundance of pasture dry matter in comparison to pastures on the North end (i.e., P7, P8, P9). When comparing the lbs of pasture dry matter produced per acre, P3 was the most productive, and P7 was the least productive.

The ability to determine which sections of the farm as performing better than other sections allows producers the capacity to target specific areas of the farm for improvements.

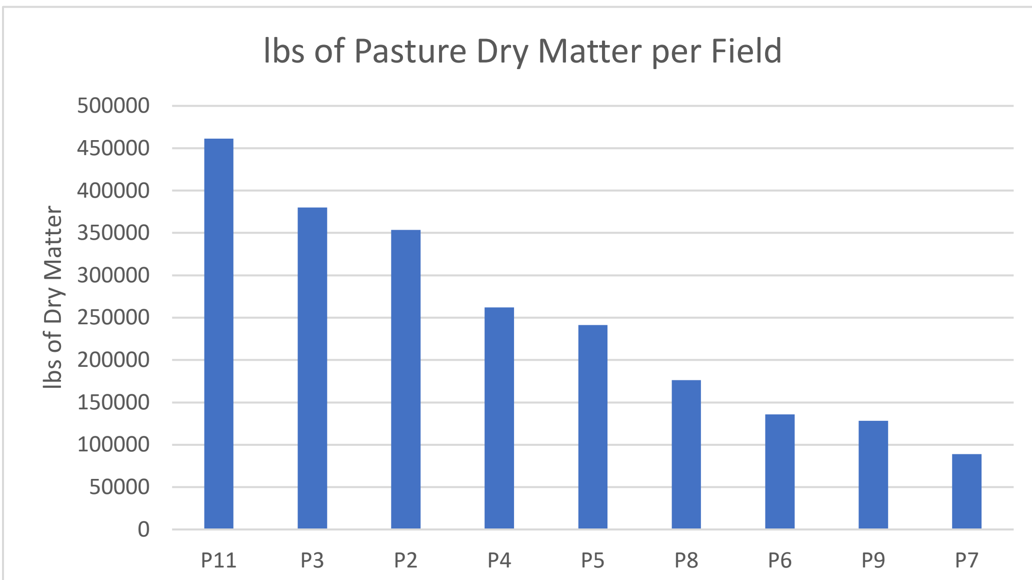

Figure 4: Graph displaying the total lbs of pasture dry matter per field produced throughout the grazing season (May 18th to August 25th) at Victoria Community Pasture.

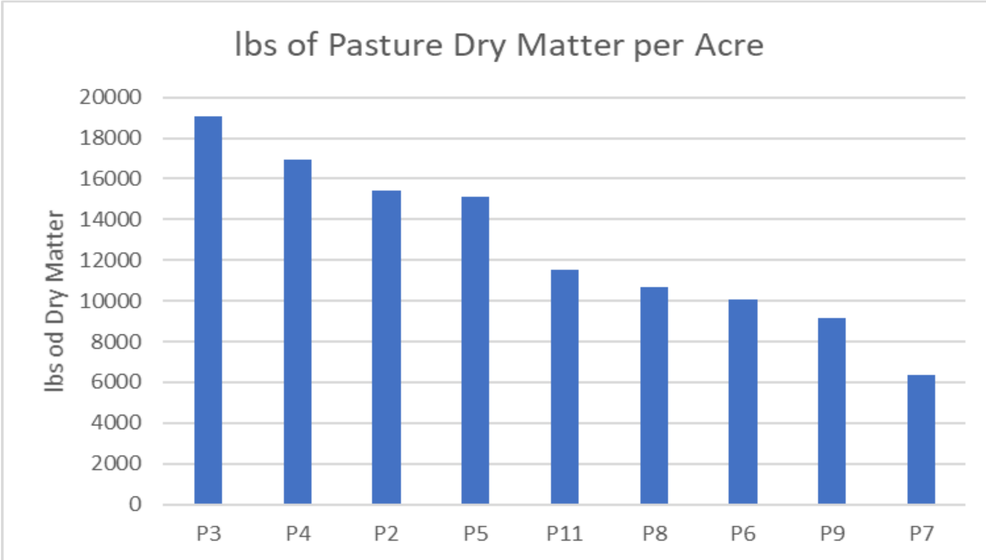

Figure 5: Graph displaying the total lbs of pasture dry matter per acre produced throughout the grazing season (May 18th to August 25th) at Victoria Community Pasture.

Conclusions

A rising plate meter is a very fast, easy and effective tool as it allows the easy estimation of pasture dry matter content without the need to collect and dry a large number of pasture samples, although initially, some pasture sampling is required to calculate pasture density. Knowledge of pasture dry matter content at any given time allows improved pasture management through better grazing decisions. Better grazing decisions enables more efficient use of available pasture, improved livestock performance and ultimately, improved farm profitability through increased output and reduced costs per unit area.

This article is the first in a series of articles that will outline the results from the OMAFRA Summer pasture project on the use of a rising plate meters as a tool for pasture management and the benefits to producers.

Note on the principal author: *The principal author of this article is Mary O'Connor, an OMAFRA Summer student who, under the supervision of James Byrne, OMAFRA Beef Cattle Specialist, assisted with this project.*

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Bovine anaplasmosis: Preventing its introduction to Ontario beef herds

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Anaplasmosis is a disease in cattle caused by infection with the bacteria *Anaplasma marginale.* Although it is a rare occurrence in Ontario, the risk of infection is likely climbing in part to climate change which may influence the movement of ticks that spread the disease. Knowing the risks for disease entry is crucial to keeping anaplasmosis infection out of Ontario beef herds.

Bovine anaplasmosis is most commonly found in tropical and subtropical areas. The disease has been reported in every state in the United States but is most prevalent in the southern Atlantic states, the Gulf Coast states, and several of the Midwestern and Western States. The introduction to naïve herds in low prevalence US states likely resulted from the transport of carrier cattle from infected herds in higher prevalence states. This is also a risk in Ontario. Sporadic cases have been reported in Canada mostly associated with the introduction of cattle from outside of Canada.

Anaplasma marginale (*A. marginale*) is host specific meaning it only causes disease in cattle. This bacteria species lives in the red blood cells of cattle. The bovine's immune system recognizes the infected cells as abnormal and removes them, resulting in anemia. The disease severity is related to the number of infected red blood cells. Young animals (less than 2 years of age) at the time of infection tend to be more resilient and may generate new red blood cells quicker, and typically show no or only mild symptoms. Older animals (older than 2 years) are more severely infected and may have an elevated temperature, severe depression, pale mucous membranes, and eventually die. If cattle herds are not monitored daily, the first sign noticed may be sudden death.

Transmission

Transmission of *A. marginale* can occur in three different ways.

1. Biologically – Ticks such as the American dog tick (Dermacentor variabilis) and the Rocky mountain wood tick (Dermacentor andersoni) which are both present in Ontario are among 20 species of ticks worldwide that can transmit *A. marginale*. Once a tick feeds on an infected bovine, the tick utilizes their salivary glands to multiply the amount of *A. marginale* and when they feed on other cattle, they also transmit *A. marginale*.
2. Mechanically –The blood-contaminated mouthparts of biting flies or blood-contaminated equipment can transfer the organism to cattle. Flies are different from ticks in that they don't amplify the bacteria, but can carry it on their mouth parts for a few hours after biting an infected bovine. Similarly, the re-use of needles or blood-contaminated equipment can pass the infection between cattle.
3. Transplacental – A small percentage of infected cattle can pass on *A. marginale* to their fetus during pregnancy. This is estimated to occur in about 10% of fetuses born to infected dams.

Disease Progression

Anaplasmosis is characterized by four phases.

1. Incubation – The time from exposure to the bacteria to developing signs of illness ranges from 3-8 weeks.
2. Clinical –When a significant percentage of red blood cells are infected, cattle begin showing signs of illness such as fever, weight loss, icterus, and recumbency. The immune system response and treatment prescribed by a veterinarian will work to halt the disease, however severely affected animals may die.
3. Recovery – As new red blood cells are produced animals will recover over several weeks to months. Cattle that are slow to recover may be culled as part of production decisions.

4. Carrier – Once cattle recover from infection they remain a reservoir of infection for *A. marginale*. Carrier animals appear normal and will rarely have a recurrence of illness associated with *A. marginale*. However, other naïve cattle can become infected when mechanical or biological transmission occurs from carrier cattle to uninfected cattle.

Preventing Anaplasmosis from Introduction into Ontario Herds

Within Canada, there is no longer a federally mandated import testing requirement for anaplasmosis. Purchasing a carrier animal is a real risk to introducing the disease to a herd that does not have the disease currently. Carrier animals may look normal when examined and if they were infected at a very young age, they may not have had signs of infection for the previous owner to witness. Once introduced, other herd members with no immunity can become infected resulting in severe disease.

Even though testing is not required for import, diagnostic tests to detect anaplasmosis are widely available and affordable. A blood sample test can be requested from the herd of origin prior to purchase. If a test was not done before purchase, animals should be tested immediately after introduction by the herd veterinarian and managed to minimize the risk of transfer of anaplasmosis or any other disease pathogen until status is known. No diagnostic test is perfect so knowing the herd of origin and inquiring about the herd status for anaplasmosis, as well as other infectious diseases, should be a first step when considering any domestic or international purchase.

Changing tick populations as a result of climate change is beyond the control of individual producers, but an awareness of the changing risk for tick-borne diseases is important for all cattle producers. Pastured animals exposed to tick vectors have an additional pathway to circulate anaplasmosis if introduced into a herd compared to non-pastured cattle. The herd veterinarian can advise on a parasite control programs to address tick concerns for the herd's geographic location. Ticks don't move very far on their own and rely on a cattle host for a ride to expand their range. For this reason, newly introduced cattle should be treated for ticks on their arrival.

Finally, ensuring that needles and any other potentially blood-contaminated equipment such as dehorning tools are not re-used between animals is important for anaplasmosis control as well as other diseases. Changing needles for example when vaccinating and disinfecting tools only takes a second but can stop a potential outbreak in a herd. One study that injected 10 naïve steers with the same needle after first injecting a known positive anaplasmosis animal found 6/10 steers became positive for anaplasmosis[7] emphasizing how important this is.

Currently anaplasmosis remains a non-endemic disease in Ontario. Attention to prevention practices can help keep it that way.

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Investigating the performance and environmental benefits from biochar supplementation to grazing beef cattle

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Now more than ever, there is increased pressure to reduce agricultural-based greenhouse gas (GHG) emissions, particularly within the beef industry. Despite the significant nutritional benefits from beef animals, the industry continues to be implicated as a major contributor of GHG emissions, specifically enteric methane (CH_4) emissions. However, meat consumption is on the rise, and as such, mitigation strategies that reduce methane emissions without compromising production efficiencies are needed. Research over the last fifteen years has investigated a number of dietary GHG-mitigation strategies, primarily feed additives, for their ability to reduce enteric methane emissions from ruminants. Traditionally, feed additives have been used to improve feed efficiency and increase animal productivity and health, but more recently there has been increased interest in the use of feed additives for methane mitigation.

Biochar, a carbon-rich product, may represent a feed additive with the potential to reduce methane emissions from beef cattle when supplemented in the diet. Biochar is produced through a process called pyrolysis, which involves heating organic matter (trees, manure, etc.) under low-oxygen conditions. The literature supports several agricultural and environmental applications for biochar, primarily owing to its large surface area, high porosity, surface functional sites, and mineral components. Supplementing biochar to soil enhances soil structure and properties, including soil pH, organic components, water retention potential, and aeration condition.

Hypothesized mechanisms for biochar's mode of action for reducing methane emissions from ruminants are primarily related to its large surface area and high porosity. Three hypotheses currently circulating the literature are:

1. Biochar may absorb gas in the rumen resulting in less methane release via eructation
2. Biochar may increase the inert surface area in the rumen resulting in improved microbial habitat
3. Biochar may alter the microbial community in the rumen

To date there is limited research that directly investigates the impact of biochar supplementation on methane emissions from beef cattle. Previous research by Leng et al. (2012) and Saleem et al. (2018) did yield positive preliminary results, with methane reductions of up to 25% reported. However, further work is required to explore the effect of biochar supplementation more thoroughly on animal performance and methane emissions.

Recently, two biochar supplementation experiments were conducted at the Ontario Beef Research Centre. The objectives of these experiments were to:

1. Determine the optimum dose of biochar to reduce methane emissions from beef cows (Experiment 1)
2. To determine whether biochar supplementation can reduce methane emissions from beef cows on pasture (Experiment 2)

Experiment 1 was conducted as a 4 x 4 Latin square, using 8 late gestation beef cows fed a high forage diet top dressed with pine-sourced biochar (Figure 1) at 0, 1, 2, and 3% of dry matter intake (DMI). To facilitate ease of feeding and encourage biochar consumption, the biochar used in this experiment was incorporated into a pellet containing 45% biochar, 42.5% wheat midds, 10% canola oil, and 2.5% dry molasses. After feed delivery each morning, the biochar pellet was top-dressed onto each cow's individual feed bin and thoroughly mixed into the diet. The experiment was divided into 4 periods, each period consisting of 21 days: 14 days for treatment adaptation and 7 days for data collection (DMI and GHG emissions).

The results from this preliminary experiment showed that methane production (grams/day; g/d) was not significantly different between the four treatment levels (*Figure 2*). However, the 3% inclusion rate was numerically lower compared to the 1 and 2% inclusion rates, and therefore this dose was selected for use in the second experiment on pasture.

Figure 1. Pine-sourced biochar used in Experiment 1 and Experiment 2

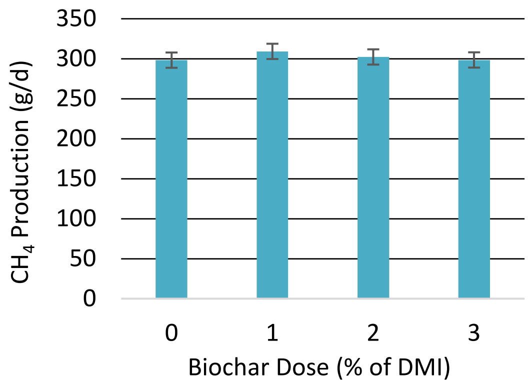

Figure 2. Methane (CH_4) emissions in g/d from cows fed biochar at 0, 1, 2 and 3% of DMI (Experiment 1)

Experiment 2 was conducted as a crossover design, using 64 cows and their calves divided into 8 groups of 8 cow/calf pairs. A rotational grazing system was used, and biochar was supplemented daily (via portable troughs) at 0 and 3% of estimated DMI. The experiment was divided into 4 periods, each period consisting of 28 days: 21 days for treatment adaptation and 7 days for data collection (estimated DMI and GHG emissions).

In both experiments methane emissions were measured using C-Lock GreenFeed trailers (C-Lock Inc., Rapid City, SD, USA; *Figure 3*). The GreenFeed system estimates daily methane and carbon dioxide production (g/d) by measuring enteric gas concentrations when the animals visit the unit. Upon entry to the GreenFeed unit, the animal's RFID tag is scanned, and then pelleted feed is dropped. While consuming the pellets, a fan pulls air past the animal's muzzle into an intake manifold, and then infrared sensors are used for continuous measurements of methane and carbon dioxide.

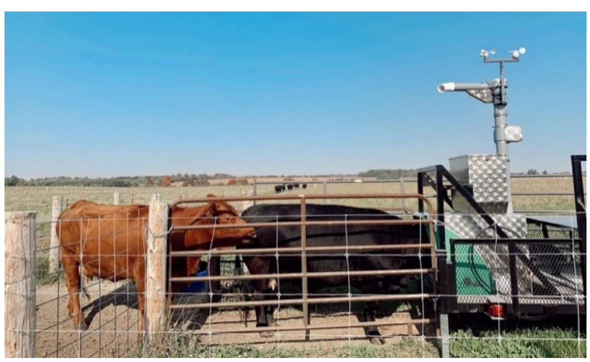

Figure 3. C-Lock GreenFeed trailer set up on pasture for measuring methane emissions in Experiment 2

The results from both experiments showed that DMI and average body weight (BW) were not significantly different between any of the treatments in Experiment 1 or 2. Similarly, methane emissions expressed as g/d, g/kg of DMI, or g/kg of BW were not significantly different between treatments in Experiment 1 or 2 (*Table 1*). Overall, biochar supplementation was not effective for reducing methane emissions from beef cattle, but animal performance was not affected.

Table 1. Enteric methane (CH_4) emissions from cows supplemented with biochar at 0 and 3% of estimated dry matter intake (DMI) in Experiment 2

Parameter	Treatment		SEM	*P*-value
	Control	Biochar		
g CH_4/d	252.77	262.50	7.38	0.35
g CH_4/kg DM	27.84	26.79	0.83	0.38
g CH_4/kg BW	0.37	0.38	0.02	0.40

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Is liquid whey a suitable feedstuff for beef feedlot rations?

Jessica Kelly, USEL student, OMAFRA and U of G*

Billions of litres of liquid whey are produced every year in Canada. Liquid whey is a byproduct of cheese manufacturing that is often dried down and used for human consumption. Liquid whey is also an energy-rich feed that can be incorporated into livestock rations, a feeding practice that has been used by livestock producers for many years. Although more commonly seen in swine feeding scenarios nowadays, liquid whey can also be fed to ruminants.

A summer project was borne out of a problem and an opportunity. Where rural cheese plants are located far from drying facilities and transportation becomes uneconomical, alternative solutions to reduce waste and create opportunities for utilization warrant investigation. One solution that has the potential to both reduce waste from the cheese plants and create cost-savings for farmers is feeding the liquid whey to cattle. The anticipated cost-savings are mutually beneficial: reduced costs of disposal for cheese plants and lower feed input costs for local cattle. Although feeding liquid whey is not a new practice, our team sought to explore how liquid whey behaves in a modern feedlot ration to fully understand the potential for feeding liquid whey to feedlot cattle in Ontario. This article provides an overview of our findings.

The Opportunities

Liquid whey is a good source of protein, energy, and minerals, which makes it a good candidate for partial displacement of expensive ingredients in a feedlot ration. Liquid whey typically has dry matter range of 6 to 7%, with 70 to 75% of the dry matter made up of lactose (an energy source), 11.5 to 12% of DM of protein, 8% of minerals, and some vitamins. However, nutrient values from different sources of whey can vary and feed testing is recommended. Because liquid whey has high moisture content, it has also been suggested that there is potential to reduce feed sorting behaviour when added to a TMR, thereby mitigating risk of digestive upsets associated with feed sorting. Research has also shown that the addition of liquid whey to silages can aid in the fermentation process and improve digestibility.

The Challenges

Although liquid whey can be fed to feedlot cattle, there are a number of factors that must be considered to ensure this practice is successfully implemented and remains cost-effective:

- **Transportation.** Due to its low dry matter, transportation of liquid whey may be costly where the feedlot is not in close proximity to the cheese plant. Intuitively, transportation costs increase with further distance from the cheese plant, reducing its cost-effectiveness.
- **Wear and tear on equipment.** Since liquid whey does have corrosive properties, any equipment or materials involved in the process of feeding it (storage units, transportation tanks, pipes) should be acid resistant. Such materials that are not acid resistant may require more frequent repair or replacement.
- **Sanitation.** Sanitation of equipment should be practiced regularly to avoid microbial and pathogen contamination.
- **Storage conditions.** Problems may arise with freezing in cold temperatures due to the high moisture content of liquid whey. Placing the storage unit below frost level in the ground can mitigate the risk of freezing. Spoilage can also occur with an increase in temperature and/or an increase in storage time. Spoilage is typically associated with a drop in pH, reduced palatability, and compromised nutritional value. It is recommended to provide fresh liquid whey to cattle as frequently as possible to reduce spoilage.
- **Matching whey supply with the feedlot.** In addition to balancing rations with whey, balancing the amount of whey available with other feedstuffs and the number of head on feed is an important logistical consideration.

Benchtop Exercise (Summer 2021)

A benchtop exercise was conducted to observe the impact of varying inclusion rates of liquid whey (2.5%, 5%, and 10% inclusion on a DM basis) on the consistency of a typical feedlot TMR. It was quickly observed that an inclusion rate of 10% (DM basis) was too high. At 10% inclusion, the TMR was ‘soupy’ with liquid whey seeping out of the ration, making it an impractical feeding scenario for feedlots. Although ration consistency was improved at the 5% inclusion rate, the TMR was not a desirable consistency. The inclusion rate of 2.5% appeared to be the ‘sweet spot’, where TMR consistency was achieved without any seepage issues.

Base Ration (0% inclusion)	2.5% Inclusion	5% Inclusion	10% Inclusion
			

Figure 1: Feedlot TMR consistency at varying inclusion rates of liquid whey (DM basis)

The benchtop exercise also included a sensory test to determine whether the inclusion of liquid whey resulted in off-odours in the TMR. The sensory test was completed after rations were left in ambient temperatures for 24 hours (June 2021). In this benchtop exercise, no off-odours were detected. Particle separation was also assessed with a Penn State Particle Separator (Figure 3). Particle separation tended to decrease as inclusion rates of liquid whey increased, suggesting that inclusion of liquid whey has the potential to reduce particle separation through feed sorting.

Figure 2: Benchtop exercise set-up at the Ontario Beef Research Centre

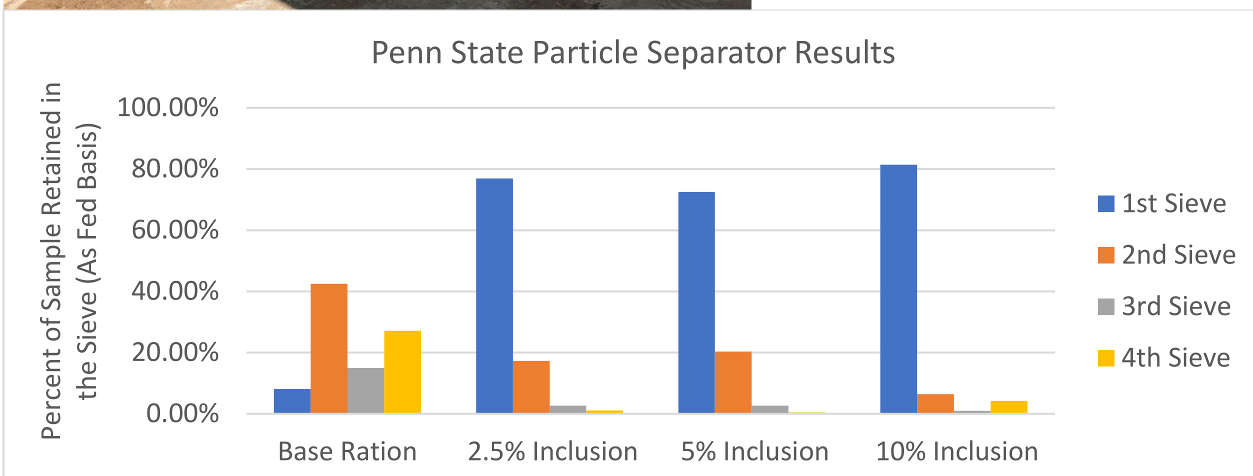

Figure 3: Retention of particles found in each sieve for rations with varying inclusion rates of liquid whey

What About Feeding Liquid Whey to Cows?

The opportunities for feeding liquid whey through a TMR were explored as part of the benchtop exercise. Since TMR feeding is not as common for cow herds, other feeding opportunities must be considered. The literature suggests that liquid whey can be offered in a trough to cows ad libitum. Cows can reach intakes of 64L of liquid whey per cow per day, decreasing their water consumption from other sources. Keep in mind that it is necessary to continue to offer a source of clean, fresh water to your cow herd.

Conclusions

The practice of feeding liquid whey to feedlot cattle can be economically beneficial for both feedlot producers and cheese plants. As the results of the benchtop exercise indicate, inclusion rates are limited by the low dry matter content of liquid whey and TMR consistency may become less desirable at inclusion rates exceeding 2.5-3% dry matter. While the feasibility of feeding liquid whey in a feedlot ration will ultimately be influenced by ingredient pricing, it can be done successfully when properly managed. There are also opportunities to offer free-choice whey to beef cows, where the water content of the liquid whey will displace some of the water consumed by the cows along with providing nutrients in the cow's diet.

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