

Salvage values of damaged faba forage and faba bean in ruminant livestock systems:-Effect of frost/frozen damage- Feed values of normal faba forage and faba bean for both beef and dairy cattle-Effect of varieties, effect of processing method, and/or effect of tannin level

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| SPG Contributions | Project Status | Duration/Timeline of Project (Year to Year) | Co-funders | Total Project Cost |
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Project Description

In Saskatchewan and Western Canada, due to cold and unexpected cold climate condition, faba bean are often frost/frozen-damaged. However, salvage value, feed value and feeding value in frost/frozen damaged faba bean forage and seeds is unknown. There is an urgent need to develop a comprehensive research program for pulse producers, industries, and livestock industry with a systematic approach to determine:

1. Salvage values of damaged faba forage and faba bean in ruminant livestock systems
2. To determine feed values of normal faba forage and faba bean for both beef and dairy cattle
3. To determine effect of faba bean varieties, effect of processing methods on faba bean to find optimal methods, and effect of tannin level on nutrient availability of faba beans
4. To develop new faba feeding strategy for both beef and dairy cattle in sustainable animal production systems in Saskatchewan and Western Canada

Hypothesis: Different varieties/lines of faba bean seeds, feed processing treatments and different tannin levels (high or low) will impact the structural, physicochemical, and nutritional characterization of normal faba beans grown in Western Canada and affect nutrient utilization and availability in ruminant livestock. The induced structural change by feed processing is highly associated with nutrient availability in animals.

Outcome

The results showed that

1. Bioactive compounds: There were significant differences in condensed tannin content between low tannin varieties (LT) and normal tannin varieties (NT): 0.46 vs 4.0 % DM. However, there was no indication that the tannin level in faba bean varieties affects nutrient absorption and supply to ruminants.
2. Chemical and nutrient profile: There were significant differences in some chemical attributes between LT faba bean and NT faba. There were no significant differences in dry matter (DM), protein (CP), carbohydrates (CHO), and fiber content (NDF) with averages 93, 28, 68 and 18%, respectively. There was no difference in hemicellulose and cellulose between LT and NT faba bean. Soluble crude protein (SCP) was highly significantly different in LT compared to NT (21 vs. 18%). The results indicate that LT faba bean and NT faba bean varieties differed in chemical profiles.
3. Cornell Net Carbohydrate and Protein System (CNCPS) sub-fractions of protein and carbohydrates: There were significant differences in protein sub-fractions between LT and NT varieties in terms of rapid, intermediate, slowly and undegradable protein fractions. PA, PB1, PB2, and PC fraction. The rapidly degradable protein fraction was significantly higher in LT than NT (74 vs. 62%) while the latter showed a higher mean on slowly degradable protein fraction compared to LT (8% vs. 5%). The results indicated that LT and NT provided different protein degradation and undegraded fractions.
4. Energy values: No significant differences were observed in total digestible nutrients, metabolic energy, and net energy for lactation and growth for dairy and beef cattle, hence tannin level did not affect energy supply to beef and dairy cattle.
5. Rumen degradation of nutrients: LT faba bean provided higher level of rumen bypass starch (BST) than NT seeds (93 vs. 84 g/kg) and rumen bypass protein. Rumen undegraded neutral detergent fiber (RUNDF) was significantly higher in NT faba bean compared to LT faba bean (109 vs. 99 g/kg DM). These results indicated that tannin level affected nutrient degradation of protein, starch and fiber.
6. Intestinal digestion: Intestinal digestibility of rumen bypass protein was significantly higher in low tannin seeds (83 vs. 75%).
7. Total truly absorbed nutrient supply from faba bean to ruminants: There were no differences in metabolizable protein, degraded protein balance, and feed milk value.

The results indicated that both low and normal tannin faba bean varieties had desirable metabolic characteristics for them to be used in ruminant diets in terms of protein and energy supply. Despite the results showing different physicochemical characteristics among the faba bean varieties, the predicted animal performance and production were not significantly different. These outcomes suggest that both LT and NT faba beans grown in Western Canada can be used as an excellent nutritive ingredient for ruminant diets without any negative tannin impact.

In Canada, the use of pulse crops as animal feed had increased in the last decade; faba beans are cultivated more often by more farmers, and are getting high interest within cattle producers as a high protein and energy source for their animals. However, detailed information about the nutrient profile and digestive behavior is still unknown by the livestock and feed industries, as well as the pulse industry. Questions regarding optimal levels of inclusion, effects of replacing other common feeds

with faba beans, true nutrient supply, and metabolism, and the effects of different tannin levels (high or low) in animal performance are common in Western Canada industries.

Canada production of pulses has been increasing since the 90's due to the growth of market opportunities as well as the implementation of new technologies by the producers. Faba bean cultivars have a great potential as a green manure crop and grain crop. Between 2014 and 2015 approximately 40 to more than 72 thousand ha. of faba beans were cultivated in Western Canada, mostly in the provinces of Alberta, Saskatchewan, and Manitoba. The continued growth of the faba bean market will result in increased returns for farmers.

Research Objective

OBJECTIVE 1

To develop higher value feeding strategy and maintain and increase business in competitive market for pulse producers and industry from lower or no value of damaged faba bean forage and damaged faba bean seeds ("try to extract high value from no value faba").

OBJECTIVE 4

To increase basic knowledge of the nutritional relevance of damaged and normal forage faba and faba bean to apply this information to the production of high quality feeding programs and to aid forage faba and faba bean breeding programs.

OBJECTIVE 2

To help pulse producers and industry to increase business, maximize profit and provide economic return and benefit to pulse producers and related industry.

OBJECTIVE 3

To build and develop alternative feeding strategies with low cost based on tannin content to efficiently utilize forage faba and faba bean in sustainable cattle production systems for improving animal production and health.