

Using Synchrotron and Global Molecular Spectroscopic Techniques to Reveal Synergistic Impact and Interactive Association Between Molecular Structure and Nutrient Properties and Supply to Dairy Cows in Enzymatic and Thermal Treated Oat Endosperm Tissue and Whole Oat Grain

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As an advanced technique, synchrotron radiation-based Fourier transform Infrared microspectroscopy (SR-FTIRM) has been a rapid, direct, non-destructive and non-invasive bioanalytical method. Global molecular spectroscopic techniques, for example, attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy and diffuse reflectance Fourier transformed infrared (DRIFT) spectroscopy, will be used. For this research, CDC Nasser, CDC haymaker, CDC Arborg and Summit with three consecutive years were studied. There are three treatments: Treatment 1, steam-pressure-treated for 0, 30, 60, and 90 minutes; Treatment 2, treated by an innovative fibrolytic enzyme (Ab) under 0, 0.5, 1.0, and 1.5 mL/kg level; Treatment 3, steam-pressure-treated and then treated by Ab. The objectives of this research were to (1) Compare the molecular structure spectral features of processed oat endosperm tissues at a molecular and cellular level using SR-FTIRM; (2) Compare the molecular structure spectral features of processed whole oat grains using ATR-FTIR or DRIFT; (3) Determine the chemical profiles, protein and carbohydrate fractions profiles (CNCPS 6.55), energy profiles, degradation kinetics, intestinal digestibility, microbial protein production and true nutrient supply. The expected results are to detect a synergistic impact between processing methods on induced changes in nutrient properties, to reveal the interactive association between induced molecular structure changes and nutrient properties and true nutrient supply, and to develop absorbed nutrient supply prediction equation based on processing induced molecular structure changes. This research is also to increase economic returns to oat producers and related dairy industries through efficient utilization of new feed-type or milling type of oat grains.

Comparing Natural vs. Induced Estrus in Dairy Heifers Using an Automated Activity Monitoring System

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In total, 609 dairy heifers from a commercial farm near Edmonton, AB were fitted with an ear tag activity monitor (SCR eSense, Allflex) once they were eligible for breeding (~13.5 months of age). Estrus events were recorded as either natural (n = 881) or induced (n = 388; within 2 to 5 d after prostaglandin administration). All heifers received sexed semen for the first AI and conventional semen for subsequent breedings. Pregnancy diagnosis was done at 30 d and confirmed at 45 d post AI and heifers had 6 opportunities to become pregnant to AI. The system recorded a heat index, maximum activity change, maximum rumination change and duration of heat. The distribution of onset of estrus and peak estrus times throughout the day did not differ between natural and induced estrus. In total, 70% of heifers started estrus between 8:00PM and 8:00AM and 73% of heifers hit peak estrus between 2:00AM to 2:00PM. Heat index (82 vs. 80, $P = 0.09$) and maximum rumination change (-49 vs. -46, $P = 0.06$) tended to be greater for induced vs. natural estrus, with no difference in maximum activity change or estrus length. There was no difference in pregnancy at 30 d (68 vs. 67%, $P = 0.79$) or 45 d (64 vs. 63%, $P = 0.82$) between the induced and natural estrus groups. However, there was a tendency for interaction between treatment and semen type for pregnancy at 45 d, in which pregnancy tended to be greater in the induced group for sexed compared with conventional semen (68 vs. 58%, $P = 0.09$).

Take Home Messages: There is little difference in estrus behaviour characteristics between natural and induced estrus. The increase in pregnancy using sexed semen in the induced estrus group is likely due to sexed semen being used in the first AI and conventional semen being used in subsequent AI in less fertile heifers. Based on the estrus distribution, a heifer reproduction program using an activity monitoring system and once a day breeding may have more success breeding in late morning, when a greater proportion of heifers are close to peak estrus.

Thank you to the Agriculture Funding Consortium for financial support, and to Breevliet Ltd and SCR by Allflex.