

Physiochemical, molecular structural and nutritional characterization of Oat grain varieties in comparison to barley grain

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New varieties of oats are constantly produced to meet the requirements of the milling and feed markets and Canada's large exportation. However, there is a limited knowledge of the nutritional characteristics of these new varieties for dairy and beef cattle in western Canada. The objectives of this study were: (1) To analyse the physiochemical parameters, energy values, feed milk value (FMV) and degradation kinetics of different varieties of CDC oats compared to CDC barley grain; (2) To reveal the relationship between protein molecular structure and digestible protein contents. Three varieties of CDC oats grain (CDC Nasser, CDC Arborg, and CDC Ruffian) and one variety of CDC barley grain (CDC Austenson) with multiple samples for each variety were obtained from CDC Crop Research Fields. Samples were ground through a 1mm screen for chemical analysis, through 0.12 mm screen for vibration molecular spectroscopy analysis (ATR-Ft/IR) and coarsely ground with a roller gap 0.508 mm for in situ incubation. Four cannulated cows were used for assessing rumen degradation kinetics. The primary protein inherent structures of Amide I (ca.1725-1575 cm^{-1}) and Amide II (ca.1574-1480 cm^{-1}) peak intensity area and height were assessed. The secondary structures of α -helix and β -sheet peak heights were determined and quantified using OMNIC 7.3 software. The results showed that CDC Nasser had similar lignin and undegradable NDF compared to CDC Austenson barley grain (1.55, 0.80 and 4.48. 5.06 % of DM), but CDC Austenson barley had a significantly higher ($P<0.01$) ME compared to CDC oats (3.10 Mcal/kg). The CDC Austenson barley had significantly lower ($P<0.01$) effective degraded protein in the rumen (EDCP, 101 g/kg of DM), but had higher ($P<0.01$) effectively degraded starch (499 g/kg of DM). CDC Austenson showed a higher ($P<0.01$) FMV and RUP when compared to CDC oats (2.63 kg milk/kg feed and 112 g/kg of DM). The molecular spectral results showed that CDC Austenson had higher ($P<0.01$) Amide I to Amide II height ratio and α -helix to β -sheet ratio (3.32 and 1.28, respectively). The Amide I to Amide II ratio showed a strongly positive correlation with %RUP ($r=0.91$, $P<0.01$), while β -sheet had a strongly negative correlation with the EDCP ($r= -0.71$, $P<0.01$). Implications: CDC Oats show high nutritional values which can be utilized as a concentrate for dairy cattle nutrition in Canada. Moreover, the protein molecular structure revealed by non-invasive vibrational molecular spectroscopy with chemometrics can be used to evaluate the nutritional value of cereal grains.