View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by University of Saskatchewan's Research Archive

Single Seed Sorting Technology and its Interaction with Processing for Food, Malt, Feed and Industrial Markets.

K. Sahtout[1], R. Newkirk[2], G. Penner[1], D. Beaulieu[1], T. Scott[1]

[1] Department of Animal and Poultry Science; University of Saskatchewan; [2] Canadian Int. Grain Institute, Winnipeg

Key word: Grain processing, near infrared reflectance technology

Summary

The animal industry is an important means of converting (recycling) low quality ingredients into high quality food for humans. Feed processing and/or additives have been and will increasingly be important in maximizing this conversion. Feed grain in general is not suitable for human consumption but can be extremely variable due to differences in physiochemical profiles and estimates of feed values. Most research has ignored such variability between seeds within a batch as there have been no reliable means of sorting individual grains. The variability of feed ingredients may impact processing. The research that will be conducted will identify the potential interaction between cereal grains and processing condition on sorted versus unsorted seeds and its impact on the nutritional value of the final feed product.

In the feed industry sorting on a large scale can increase consistency in final product. Sorting of seeds has been practiced for decades with a number of different methods used. The new BoMill seed sorting technology (www.bomill.com) was recently developed in Sweden for sorting individual kernels of wheat, barley and durum using near infrared reflectance (NIR) technology. Each unit can sort approximately 30,000 seeds / second or 3 MT/hr. In a facility operating at economies of scale, 10 units would have the capacity to sort 250,000 MT/yr; the estimated cost for owning and operation is estimated to be $10/MT. In Sweden the milling industry is using this technology to sort downgraded grains into high crude protein seeds for flour and lower quality grain for vodka and feed production. The technology has been used in

Australia for malt barley and the outcome was the sorting improved the consistency of the production of malt by sorting for hydration rate. Studies using near infrared spectroscopy has also identified that wheat infected with Fusarium and Ergot (source of mycotoxin contamination) can be separated with great precision from non-infected wheat grain (Delwiche, 1995; Peiris et al., 2010). This separation could increase the quality and safety of the final grain product. In addition the infected grain could be either completed removed from the industry or could be detoxified (e.g., by microbial fermentation) and used in the feed industry or moved to industrial markets. Removal of fusarium damaged kernels may also reduce the infestation of new crops and improve yield and value. Seed sorting can ensure that quality requirements for end markets are met more consistently and may reduce the use of subjective grading. Sukwon (2011) indicated that using NIR based method when sorting may be more cost effective than using a UV-VIS method.

There are a few questions that have to be answered prior for such technology becoming widely available in North America. Does sorting of grain improve consistency of final product? Does sorting of grain require a change in processing conditions? Is there an interaction between sorting of grain, processing of grain and nutritional value of the final feed product? When is it economical to sort of feed grain and when is it not?

Reference

Delwiche, S. R. 1995. Single wheat kernel analysis by near-infrared transmittance: protein content. Cereal Chemistry **72 (1)**: 11-16.

Peiris, K. H. S., Pumphrey, M. O., Dong, Y., Maghirang, E. B., Berzonsky, W. and Dowell, F. E. 2010. Near-Infrared Spectroscopic Method for Identification of Fusarium Head Blight Damage and Prediction of Deoxynivalenol in Single Wheat Kernels Cereal Chem **87 (6)**: 511-517.

Sukwon, K. 2011. NIR Spectroscopy for Chemical Composition and Internal Quality in Foods. Pages 113-147 Emerging Technologies for Food Quality and Food Safety Evaluation. CRC Press.

Single seed sorting technology and its interaction with processing for food, malt, and feed value.

Khalil Sahtout[1], Rex Newkirk[2], Greg Penner[1], Denise Beaulieu [1], Tom Scott[1]
[1] Department of Animal and Poultry Science; University of Saskatchewan; [2] Canadian Int. Grain Institute, Winnipeg

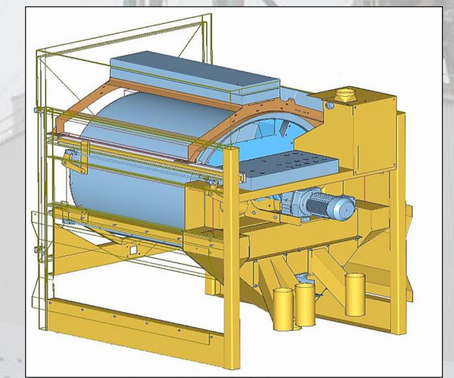
Seed sorting using NIR and its potential impact on processing

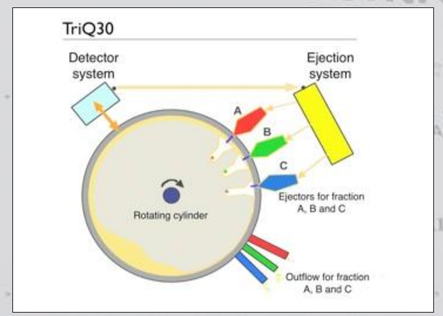
- **Improve** (Alava et al., 2001, Henry, 1985 and Tragoonrung et al., 1990):
  - **Consistency of the flour or malt product.**
  - **Nutritional quality of the final product.**
- **Develop new niche products.**
- **Sort for crude protein** (Kays et al., 2000) **to improve baking quality of wheat.**
- **Sort for crude protein to improve malting quality by choosing low protein and higher starch content for malting.**

Example of an NIR sorting machine: the BoMill seed sorter TRIQ30

- **Uses near infrared reflectance technology (NIR) to sort individual kernels of wheat or barley**
- **Contains 96 NIR detector in each unit.**
- **Sort approximately 30,000 seeds/second or 3 MT/hr**
  - **operating at economies of scale (10 units) ~250,000MT/yr**
- **Sorts into 3 quality fractions.**
- **Cost for equipment and operation is ~$10/MT.**

BoMill TRIQ30





Examples of seed sorter use in other countries

- **Sweden**
  - **Used to sort downgraded grains into high protein (>12% CP) seeds for flour and lower quality grain for vodka and feed production.**
- **Australia**
  - **To improve the malting quality of barley by selecting seeds based on uniform hydration rate.**
- **BoMill TRIQ30 first installation in North America at the Canadian Feed Research Centre (North Battleford, Saskatchewan).**

Potential benefits to the feed and food industry

- **Sorting of grain can benefit the industry by:**
  - **Increasing uniformity of seed**
  - **Grain can be upgraded to a higher level by removing low quality grain from the batch.**
  - **Reduce transmission of fusarium / ergot** (Fernández-Ibañez et al., 2009)
    - **Increase yield and safety by reducing mycotoxins**
- **Can sort gain into high protein/quality lots and sell it at a premium.**
- **Opportunities to mill the highest quality and sell a unique flour product.**
- **Reduce the requirement for grading??**

References:
Alava, J., Millar, S. and Salmon, S. 2001. The determination of wheat bread making performance and bread dough mixing time by NIR spectroscopy for high speed mixers. Journal of Cereal Science **33 (1)**: 71-81.
Fernández-Ibañez, V., Soldado, A., Martínez-Fernández, A. and Roza-Delgado, B. d. l. 2009. Application of near infrared spectroscopy for rapid detection of aflatoxin B1 in maize and barley as analytical quality assessment. Food chemistry **113**: 629-634.
Henry, R. J. 1985. Use of a scanning near-infrared reflectance spectrophotometer for assessment of the malting potential of barley. Journal of the Science of Food and Agriculture **36 (4)**: 249-254.
Kays, S. E., Barton, F. and Windham, W. 2000. Predicting protein content by near infrared reflectance spectroscopy in diverse cereal food products. Journal of Near Infrared Spectroscopy **8 (1)**: 35-43.
Tragoonrung, S., Hayes, P. and Broich, S. 1990. Near-infrared reflectance estimates of grain protein and malt extract in hill and row plot evaluations of spring malting barley. Canadian Journal of Plant Science **70 (1)**: 71-78.