Analysis of Pregerminated Barley Using Hyperspectral Image Analysis

Pregermination is one of many serious degradations to barley when used for malting. A pregerminated barley kernel can under certain conditions not regerminate and is reduced to animal feed of lower quality. Identifying pregermination at an early stage is therefore essential in order to segregate the barley kernels into low or high quality. Current standard methods to quantify pregerminated barley include visual approaches, e.g. to identify the root sprout, or using an embryo staining method, which use a time-consuming procedure. We present an approach using a near-infrared (NIR) hyperspectral imaging system in a mathematical modeling framework to identify pregerminated barley at an early stage of approximately 12 h of pregermination. Our model only assigns pregermination as the cause for a single kernel’s lack of germination and is unable to identify dormancy, kernel damage etc. The analysis is based on more than 750 Rosalina barley kernels being pregerminated at 8 different durations between 0 and 60 h based on the BRF method. Regerminating the kernels reveals a grouping of the pregerminated kernels into three categories: normal, delayed and limited germination. Our model employs a supervised classification framework based on a set of extracted features insensitive to the kernel orientation. An out-of-sample classification error of 32% (CI95%: 29–35%) is obtained for single kernels when grouped into the three categories, and an error of 3% (CI95%: 0–15%) is achieved on a bulk kernel level. The model provides class probabilities for each kernel, which can assist in achieving homogeneous germination profiles. This research can further be developed to establish an automated and faster procedure as an alternative to the standard procedures for pregerminated barley.