

AUTOMATIC MOLD ANALYSIS IN BLUE CHEESE

**Vladimira Ganchovska^{1*}, Atanaska Bosakova-Ardenska¹, Hristina Andreeva¹,
Angel Danev¹, Peter Panayotov², Petya Boyanova²**

**¹Department of Computer Systems and Technologies, University of Food Technologies,
Maritza Boulevard 26, 4000 Plovdiv, Bulgaria**

**²Department of Milk and Dairy products Technology, University of Food Technologies,
Maritza Boulevard 26, 4000 Plovdiv, Bulgaria**

***e-mail: mironka@abv.bg**

Abstract

The presence of areas with growth mold and their distribution in cheese matter are significant factors for blue cheese quality. Traditionally these parameters are evaluated by sensory profiling using experts' knowledge. Thus the assessment is subjective and performance time variate depends on current providing of experts services. Previous researches proof that methods of computer vision could help for fast and accurate analysis of quantity of mold on the blue cheese cut surface. The methods of statistical analysis also could support mold analysis in blue cheese in order to be evaluated the evenness of their distribution. The main purpose of current research is to propose an approach for automatic mold analysis in blue cheese using CVS (Computer Vision System) and software tools included in NI LabVIEW environment in order to perform complex analysis of mold growth.

The selected blue cheese trademarks were: Bergader, Dorblu with 50% fat, Dorblu with 55% fat, Paladin ReginaBlu, and Steffel Gran Bavarese. Every sample is cut on slices and these slices are evaluated by experts and captured with digital camera in CVS. An upgraded CVS is used for data acquisition and a specially developed application in NI LabVIEW environment processes cheese images and presents reports for quantity of mold and its distribution using different grid size. Assessment of blue cheese quality is performed by experts using Likert scale for two parameters-quantity of mold and evenness of their distribution. This scale assign points for naturally described scores about blue cheese quality. A correlation analysis is performed for assessments of blue cheese quality received through computer analysis and experts estimation in order to be evaluated effectiveness of proposed approach.

The results show that experts' estimation about quantity of mold strongly corresponds with calculated value using developed application (Pearsons' coefficient is ≈ 0.96) and experts' estimation about evenness of mold distribution also corresponds with calculated values (Pearsons' coefficient is ≈ 0.99) using grid size 4 x 4 and thresholding methods Inter-class variance and Clustering. It is observed that when the quantity of mold is very small (mean value below 1%) and standard deviation about its value is also small (below 0.3), then the calculated factor of evenness has high value because more of ROIs have also very small quantity of mold. The samples with high quantity of mold (in the range from 3% to 4%) are presented with high standard deviation (in the range from 1.5 to 3.5) which could be explained with presence of areas (ROIs) with quantity of mold smaller than mean value.

As a conclusion the automatically reported values for quantity of mold and factor of evenness distribution are enough to support the control of quality of blue cheese regarding the mold presence and distribution.

Key words: *Computer Vision, Blue cheese, Food quality, Image segmentation.*