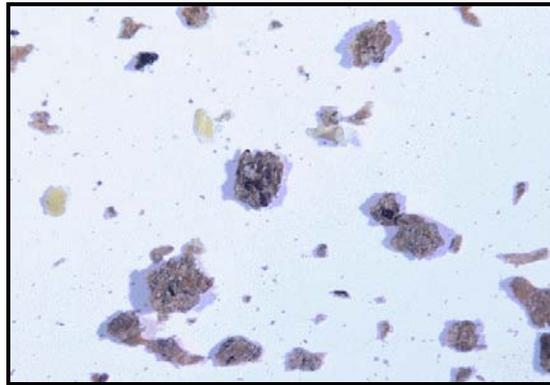


 **CLEMEX**
Image Analysis Report

188



Cow Meat Characterization

Sample Description

One pouch of cow meat.

Purpose of Analysis

Demonstrate the ability of the image analyzer to discriminate and measure the meat flakes according to their color.

Equipment Used

Image Analysis System: Clemex Vision Software (640)
Macro stand: Kaiser RS3
Camera: JVC KY-F55B
Zoom: Computar zoom lens 18 108/2.5

Procedures



The procedures described here were performed using a macro stand equipped with a color camera and a zoom lens. The calibration factor was 0.0392 mm/pixel. Fifty fields were analyzed. Each field measured 499.765 mm².

Figure 1 shows the binarization by *Color Thresholding* of the original image (cover page). Yellow pixels were binarized in yellow and black pixels were binarized in blue. A *Guard Frame*¹ (red) was applied to eliminate all incomplete objects at the edges of each field.

Artifacts were removed from the yellow and blue bitplanes using a *Trap* instruction. Gray objects were binarized in red by *Gray Thresholding*. The red bitplane was combined (*Boolean Or*) with yellow and blue bitplanes to obtain a binarization of all objects in red. Little holes were removed from the red bitplane using *Invert*, *Opening* and *Chord Size*. Remaining objects with holes were considered as a group of touching objects and were separated using the *Separate* instruction. Figure 2a shows all objects binarized in red with yellow objects overlapped in green. Figure 2b shows all objects binarized in red with black objects overlapped in green.

¹As long as the top leftmost point of an object is outside the *Guard Frame*, this object will not be included in object measures.

Very small red objects were considered as dust and were removed using a *Chord Size* instruction. Red objects that had a yellow overlap of 35% or more were transferred into the yellow bitplane (*Object Transfer on Child Area Percent*). Similarly, red objects that had a blue overlap of 35% or more were transferred into the blue bitplane. Figure 3 shows the resulting bitplanes just before measurement.

Object Measures (Area and Length) were performed on the 3 bitplanes. *Area Measures* were also performed to obtain area percentages of each bitplane over the entire analysis. The area percentage of each bitplane is shown in Figure 4.

The most significant image modifications and final results are as follows:

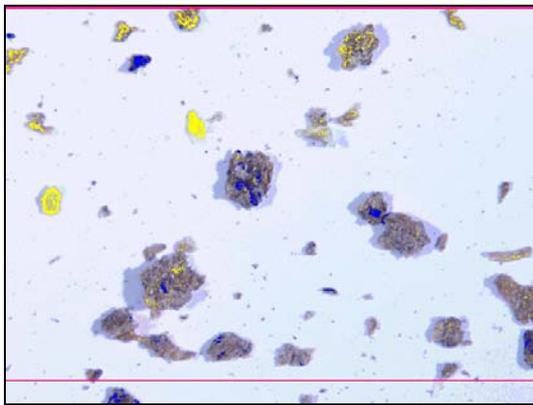


Figure 1: Yellow pixels were binarized in yellow and black pixels were binarized in blue using a *Color Threshold* instruction.

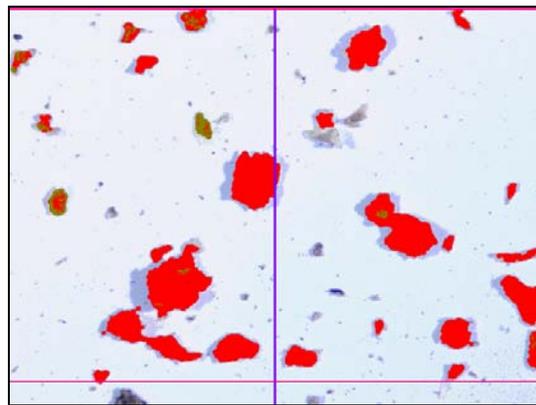


Figure 2a: All objects were binarized in red with yellow objects overlapped in green.

Figure 2b: All objects were binarized in red with black objects overlapped in green.

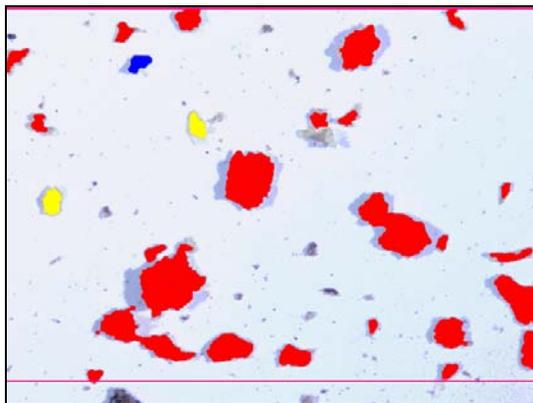


Figure 3: Bitplanes prior to measurement.

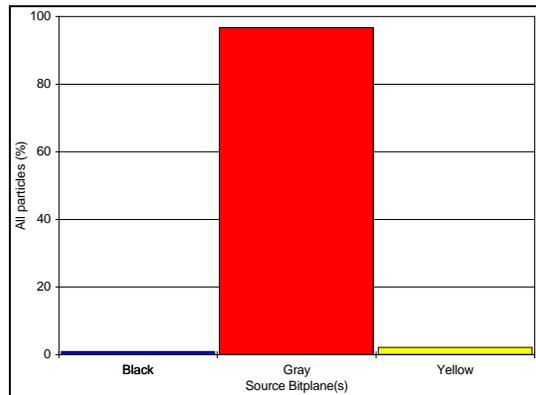


Figure 4: Area percentage of each bitplane.

Results Summary

	<i>Area Percentage (%)</i>
<i>Black Flakes</i>	1.08
<i>Gray Flakes</i>	96.66
<i>Yellow Flakes</i>	2.26

Discussion



The image analysis system can discriminate and measure the meat flakes according to their color.

A color camera was necessary to perform this analysis since the yellow flakes had the same gray intensity as the flake shadows. The same color rarely covered the entire flake. The area percentage criterion to identify objects as being yellow or black, was arbitrarily set to 35%. This gave good results.

To perform the analysis, flakes were sprinkled over a white sheet of paper. The sheet was shaken to obtain a more uniform flake distribution and to minimize the amount of flakes in contact with one another. Despite this, some flakes touched their neighbors.

When a hole of certain size was found in a feature, this feature was identified as a “multiple flake object”. These objects were separated using the *Separate*² instruction. Some false flakes were created by this procedure and some adjacent flakes remained connected. Nonetheless, the final detection was deemed acceptable.

Flakes in contact with one another could be deleted instead of separated. However, with this approach, a greater quantity of flakes would have to be analyzed to obtain a representative sample. Also, analyzing several samples from the same pouch would help to increase the accuracy of the results.

² The *Separate* instruction uses an algorithm based on the convexity of objects. It is a morphological filter that separates features by distance analysis.