Objective

The visual aspect of some food products may change over time and some defects may appear that can negatively influence the consumers in their choice. For example, chocolate is known to whiten in places over storage, the phenomenon being referred to as chocolate "fat blooming".

This study proposes to set-up a method for an objective and automated visual inspection of chocolate using a Visual Analyzer.

IRIS Electronic Eye

IRIS analyzer achieves a detailed visual assessment of both color and shape parameters of the overall products or selected portions of these products.

Camera imaging
- 16 million colors imaging
- Integrated zoom
- Automated monitoring by software

Light cabin
- Reproducible lighting conditions, D65 compliant, 6700°K color temperature
- Top and bottom lighting (backlighting to avoid shadow effects)
- Large measurement surface (420 x 560mm)

E-Eye Alphasoft software
- Data acquisition
- Automated color calibration
- Data processing (color and shape analysis)
- Multivariate Statistics (Principal Components Analysis, Statistical Quality Control, etc)

Figure 1: IRIS Electronic Eye

Samples & Analytical Method

Two batches of chocolate were compared, one of normal quality, one of unsatisfactory quality i.e. with fat blooming on its surface (fig. 2).
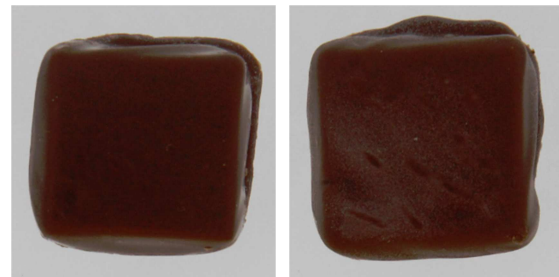

Figure 2: Pictures of 2 chocolates batches (left: good batch, right: unsatisfactory batch)

Color Analysis

For color analysis, the background of the chocolate pictures was first removed in order to focus on the chocolate color only (fig. 3).
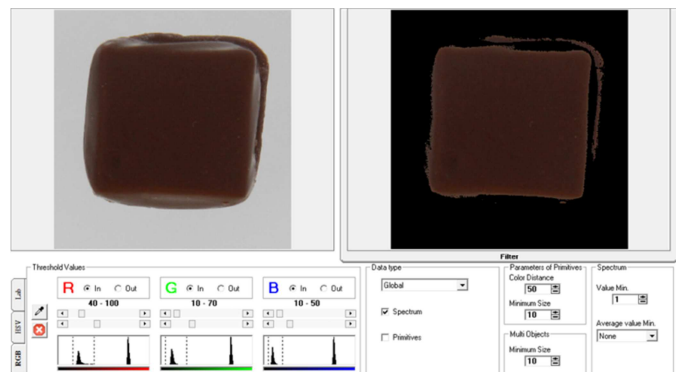

Figure 3: Pre-processed picture of chocolate (color filtering for removing the picture background)

The pictures of chocolate can be processed as a color spectrum (fig.4) representing the proportion of each color (percentage) on the chocolate surface, within a fixed scale of 4096 colors. Each of the 4096 colors corresponds to a unique set of 3 values in the RGB (Red Green Blue) space.
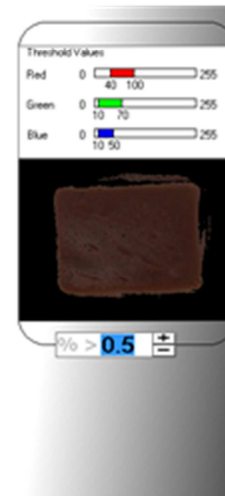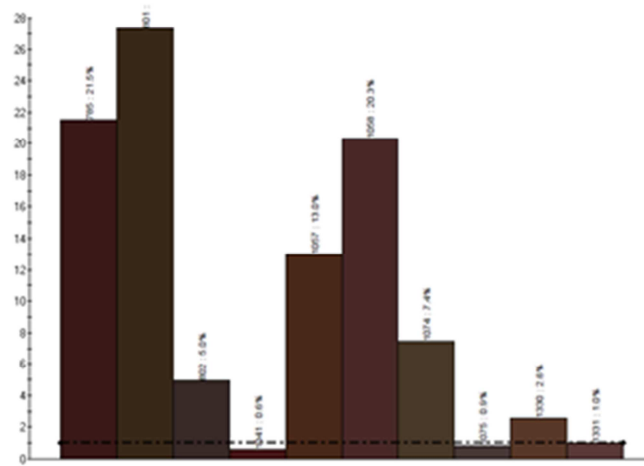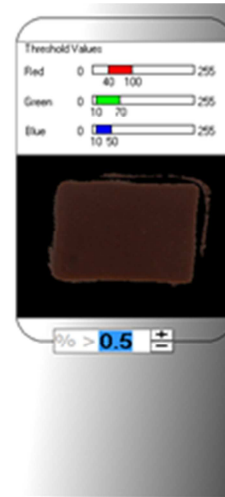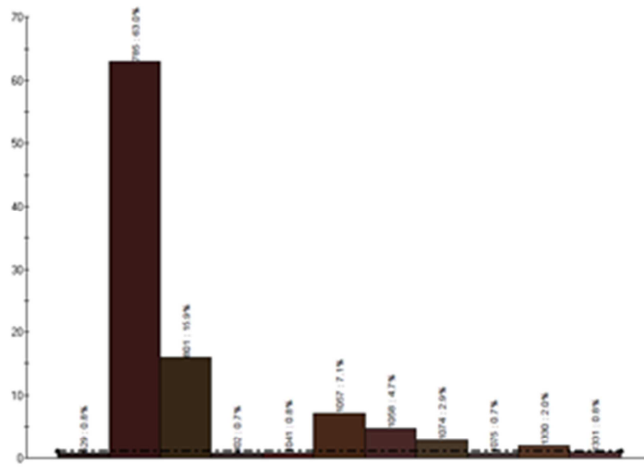
Figure 4: Color spectrum of the 2 batches of chocolate (Top: normal quality – Bottom: bad quality)

The comparison of the color composition of each picture shows clear differences.

	529	785	801	802	1041	1057	1058	1074	1075	1330	1331
Good	0.777	62.970	15.920	0.692	0.763	7.100	4.730	2.890	0.738	1.970	0.840
Bad	0.037	21.480	27.340	4.950	0.590	12.960	20.330	7.450	0.861	2.560	0.991

Table 1: Proportion (%) of each color in chocolate batches

Colors can be clustered into 3 distinct groups:

- Colors 529, 785, 801 are specific to normal chocolate

- Colors 1041, 1330, 1391 are linked with light reflexion

- Colors 1057, 1058, 1074, 1075 are found in blooming chocolate and are also related with light reflexion.

	Colors of "normal chocolate" (%)	Colors of llight reflexion & blooming defect (%)
Good	80	19
Bad	49	50

Table 2: Proportion (%) of each group of colors in chocolates

The calculation of the area percentage for each group of colors shows a clear difference between the 2 batches of chocolate (table 2).
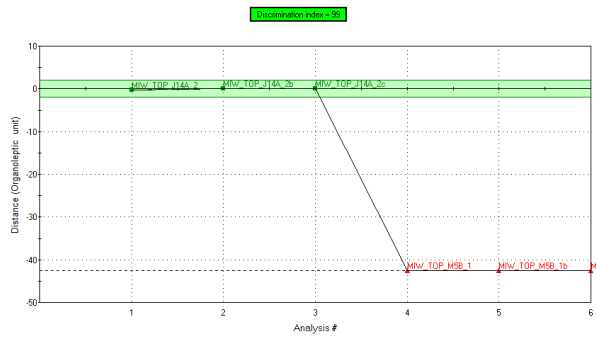
Figure 5: Quality Control Card of chocolate

To automate the visual quality control of chocolate, the visual parameters measured with IRIS analyzer are processed using Statistical Quality Control (SQC) model.

On the quality control card obtained (fig. 5), the green band represents the area of acceptable quality. All samples plotted outside this green band are considered as unsatisfactory i.e. with blooming defect.

Conclusion

This analysis shows that the visual inspection of chocolate can be successfully achieved with IRIS visual analyzer, in order to determine the proportion of the fat blooming defect and to assess the overall visual conformity.