Grana Cheese monitoring by low cost pocket size near infrared sensor

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Introduction

Parmigiano Reggiano and Grana Padano PDO are both semi-fat cheeses with strict rules about maximum fat content. Cheese producer must remove some milk cream in order to stay within the limits of fat content, but they don't want to remove too much and reduce cheese yield (CY). Near infrared spectroscopy (NIRS) is able to monitor the cheese quality, thus, its use would save a lot of money and time (Da Costa Filho and Volery). The main limitation of this technique is still the costliness of the NIR instrument, especially for the small producers, so the aim of this study was to evaluate the performance of NIRS calibrations to predict the quality of Grana Padano PDO CY with a low cost
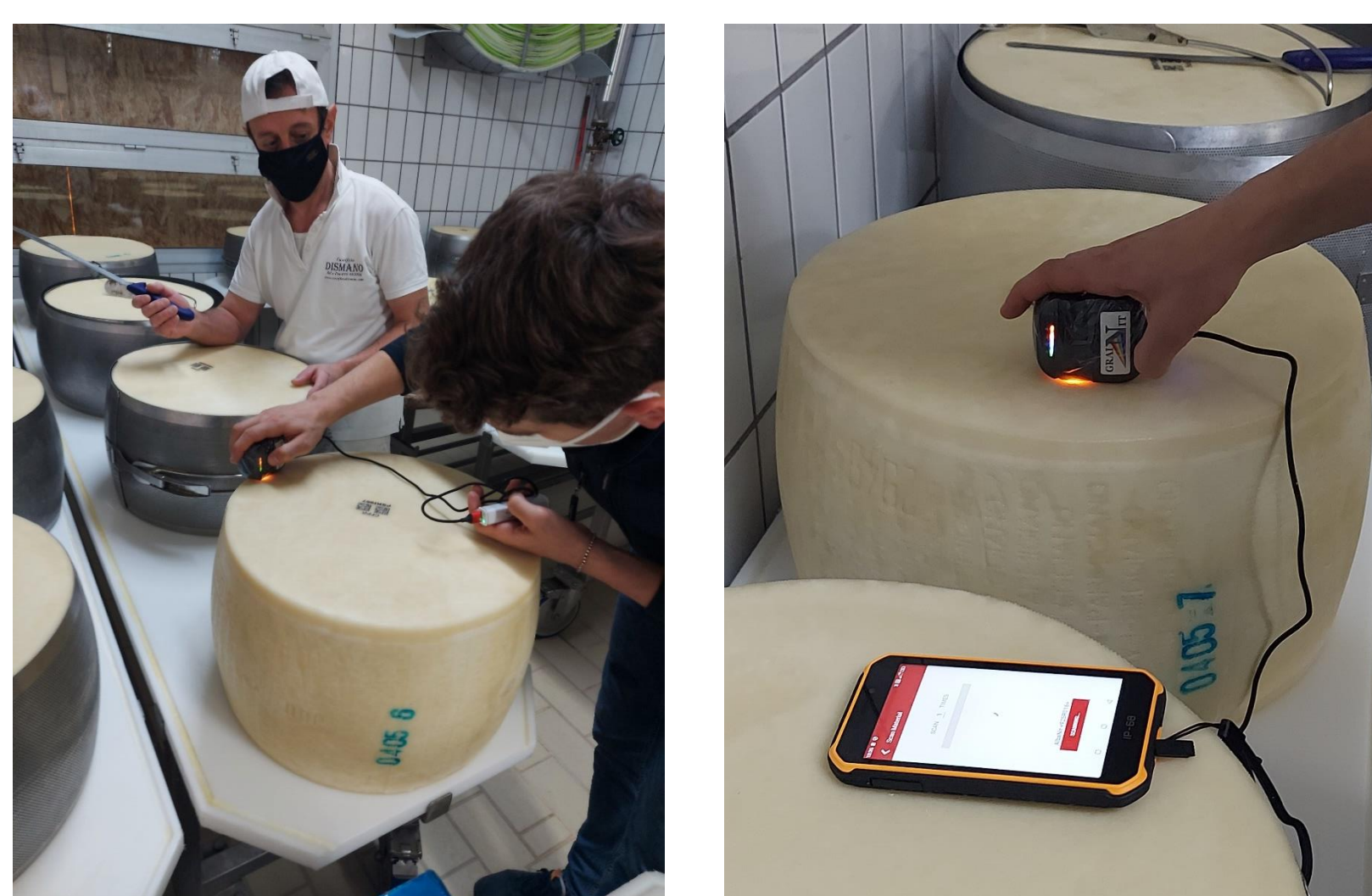
Pictures: Use of DLP at a cheese plant, scanning Parmigiano Reggiano wheels 24h old.

Conclusion

This study shows that a low cost DLP handheld can quickly detect the quality of fresh cheese by cloud computing. The low cost would allow small producer to monitor the quality of their production improving yield and profitability.

Materials and Methods

Grana cheese wheels (n.176) from different plants were sampled and scanned at 5 spots using a digital light processor instrument (DLP; AlbaNir, GraiNit srl, Italy; DLP) covering the range 950-1650 nm. Samples were placed in plastic bag, and frozen at -20 C till the analysis. Each sample was analyzed for moisture, protein (Nx6.38) and fat. Test set samples were selected by Kennard Stone algorithm, and calibration development was performed using the software R Version x64.4.1.0, based on algorithms. Mathematical spectral pre-treatments included, Standard normal variate (SNV), Detrend, Savitzky-Golay (SG) first derivative with a window size of 7 point. The performance of the prediction models was evaluated by the r^2val, Bias and Standard Error of Prediction (SEP).
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Results

Moisture had very good prediction performances both in calibration, then confirmed also with the test set with SEP and r^2val of 0.90 and 0.97 and RPD >5.

Protein and fat calibrations had good accuracies with error below 1%, for both DM and as is basis. However, r^2val of DM basis were 0.51~0.55 indicating a small range of variation of the dataset. The problem is that cheese plants try to stay within product specification, making difficult to obtain large range of variation.

In the future, it would be advisable to concentrate in expanding the data sets including samples with a broader composition.

Table 1. PLS Calibration and cross validation statistics for predicting parameters on cheese with DLP Instrument

Parameter	Calibration (n.146)				Test-set (n. 30)					
	PLS factors,n	SECV	RSQcv	RPD cv	r^2val	SEP	Slope	Bias	SEP/SECV	RPD
Moisture %	6	0.65	0.99	9.78	0.97	0.90	0.98	-0.17	1.38	5.68
Protein % DM	8	0.74	0.66	1.73	0.55	0.73	0.72	-0.08	0.99	1.49
Fat % DM	8	0.67	0.72	1.92	0.51	0.76	0.70	0.01	1.13	1.43
Protein % as is	9	0.34	0.99	11.02	0.94	0.78	0.96	0.14	2.29	4.12
Fat %as is	6	0.89	0.90	3.27	0.78	0.90	0.88	-0.05	1.01	2.10

References
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