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Prediction of cheese-making properties of Montbéliarde milks used for PDO/PGI cheeses production in Franche-Comté by mid-infrared spectrometry

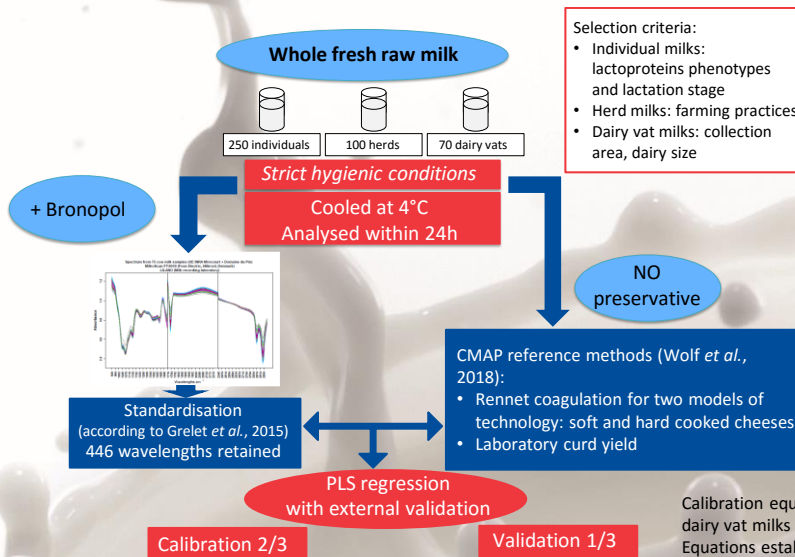
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FROM'MIR study aimed to examine the feasibility of predicting, by mid-infrared spectroscopy (MIRS), cheese making properties (CMAP) of French Montbéliarde milks from the Franche-Comté cheese production area (4 PDO + 2 PGI cheeses).

Method: Samples collection and analyses ; calibration equations



Calibration equations were developed on individual milks dataset ①, herd milks ②, dairy vat milks ③, entire dataset ④ and herd-dairy vat milks ⑤. Equations established on entire dataset were projected again at each scale.

Results: Fitting statistics of prediction models in external validation (not shown: equations with $R^2 \leq 0.5$)

Individual milks:

Parameter	N	RSD	R ²	RPD	Best equation	
Laboratory curd yields	Curd yield in dry matter (CY DM), %	245	1.78	0.93	3.73	④
	Actual curd yield (CY actual), %	245	3.25	0.88	2.89	④
	(g milk fat+g milk protein)/kg curd (CY FAT-PROT), g/kg	244	15.51	0.65	1.68	④
Coagulation – Soft cheese, pH 6.45	Curd firmness at clotting time (aR)	249	1.50	0.79	2.19	④
	Curd firmness at 2 times R (a2R)	249	1.32	0.76	2.03	④
	Curd-firming rate (Tg10)	249	3.72	0.63	1.64	④
	Curd-firming time standardized for R (K10/R)	72	0.07	0.58	1.53	①
Coagulation – Pressed cooked cheese, pH 6.6	Curd firmness at clotting time (aR)	241	1.32	0.82	2.38	④
	Curd-firming rate (Tg10)	242	1.83	0.63	1.63	④

④ Statistics obtained with projection of the entire dataset equation on the considered scale

N = Number of samples after removing outliers

RSD = Residual Standard Deviation for validation dataset

R² = coefficient of determination in validation

RPD = Ratio Performance Deviation

R² (Coppa et al., 2010):

Excellent : > 0.91, Good : between 0.82 and 0.90, Fair : between 0.66 and 0.81, Poor : < 0.66

RPD (Viscarra Rossel et al., 2006):

Excellent : > 2.5, Very good : between 2 and 2.5, Good : between 1.8 and 2, Fair : between 1.4 and 1.8, Poor : RPD between 1 and 1.4

Herd milks:

Parameter	N	RSD	R ²	RPD	Best equation	
Laboratory curd yields	CY DM, %	28	1.21	0.77	2.07	②
	CY actual, %	28	1.86	0.77	2.04	②
Coagulation – Soft cheese, pH 6.45	aR	49	0.73	0.64	1.64	⑤
	Tg10	49	1.54	0.51	1.41	⑤
Coagulation – Pressed cooked cheese, pH 6.6	K10/R	26	0.02	0.73	1.88	②
	aR	94	0.78	0.62	1.61	④
K10/R	27	0.03	0.68	1.73	②	

Dairy vat milks:

Parameter	N	RSD	R ²	RPD	Best equation	
Laboratory curd yields	CY DM, %	50	1.11	0.68	1.75	⑤
	CY actual, %	19	1.46	0.58	1.50	③
Coagulation – Soft cheese, pH 6.45	aR	49	0.73	0.64	1.64	⑤
	Tg10	49	1.54	0.51	1.41	⑤
	K10/R	49	0.03	0.64	1.64	⑤
Coagulation – Pressed cooked cheese, pH 6.6	aR	49	0.76	0.53	1.44	⑤

Conclusion

Laboratory curd yield is better predicted than milk coagulation properties whatever the dataset used. For all parameters, the best performances were obtained on individual milks with equations developed on the entire dataset. For herd milks and dairy vat milks, specific datasets must be used to have the best equation. However, performances were always lower than those established for individual milks. Cheeses will be manufactured to compare CMAP in laboratory conditions or estimated by MIR and actual CMAP.

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