

EVALUATION OF THE BUCHI NIR PROXIMATE ANALYSER

The NIR Proximate is a polyvalent near infrared analyser manufactured and commercialised by Buchi. It is used for the determination of dry matter, fat and total nitrogen in a wide range of food matrices.

The instrument is equipped with reflection and transflection measurement, allowing measurements to be taken from the top or bottom of the sample. Samples are placed in a metal holder resting on a pivoting magnetic mount to provide a view of the entire sample during analysis.

The instrument was installed in a temperature-controlled room by Buchi.



1. THE TESTS

The evaluation tests were performed in ACTALIA Cecalait's physico-chemistry laboratory from May to August 2024. The intralaboratory reproducibility, the repeatability, and the accuracy for dry matter, fat and total nitrogen were evaluated.

The accuracy of the instrument was evaluated according to the following standardised methods:

- Dry matter: Oven method according to ISO 5534
- Fat: : Acido-butyrometric method according to NF V04-287
- Total nitrogen: Kjeldahl method according to ISO 8968-1

The study was performed using the ISO 8196 and ISO 21543 standards.

2. EVALUATION OF THE INTRALABORATORY REPRODUCIBILITY

The intralaboratory reproducibility was evaluated by analysing 3 samples of cheese [processed cheese (FFO), soft cheese (FPM), grated hard cheese (FPPC)], corresponding to different matrices and compositions, at a rate of one analysis per sample every 15 minutes during 15 measurement cycles.

The following table presents the results obtained by criterion and tested matrix:

		M	Sr	Sr(%)	SR	SR(%)	r	R
Dry matter	FFO	43.98	0.05	0.10	0.26	0.58	0.13	0.71
	FPM	52.63	0.03	0.06	0.48	0.91	0.09	1.33
	FPPC	63.67	0.06	0.09	0.37	0.58	0.15	1.02
Fat	FFO	26.52	0.04	0.16	0.26	0.98	0.12	0.72
	FPM	34.21	0.04	0.13	0.32	0.95	0.12	0.90
	FPPC	32.80	0.05	0.14	0.29	0.88	0.13	0.80
Total nitrogen	FFO	14.51	0.03	0.20	0.06	0.41	0.08	0.17
	FPM	14.95	0.02	0.14	0.16	1.06	0.06	0.44
	FPPC	26.44	0.04	0.16	0.35	1.31	0.11	0.96

Table 1: PROXIMATE stability criteria for dry matter, fat and total nitrogen¹

¹ M: mean ; Sr and SR (Sr% and SR%): absolute (and relative) standard deviation of repeatability and reproducibility; r and R: maximum deviation of repeatability and reproducibility in 95 % of cases.

The standard deviations of reproducibility vary:

- between 0.58 and 0.91 % for dry matter
- around 1 % for fat, and
- between 0.41 and 1.31 % for total nitrogen.

3. EVALUATION OF THE REPEATABILITY AND ACCURACY

3.1 – Samples and models used

The tests were performed using 30 samples of hard cheese, collected at the level of their marketing (hypermarkets and supermarkets, dairy stores).

The samples were analysed using Proximate with the prediction models presented below. These models were defined from a basic model enriched with a first series of samples of the same type.

Name	Version
Fromage.ES.cal	1.2.90
Fromage.MG.cal	1.2.90
Fromage.MAT.cal	1.2.90

3.2 – Repeatability

The repeatability of the instrument was performed by analysing 30 hard cheese samples, in consecutive duplicates. The repeatability indicators (S_r and r) were calculated according to the ISO 5725-2 standard recommendations.

The following table presents the results obtained for the 3 tested criteria:

	n	min	max	M	S_r	$S_r\%$	r
Dry matter (g/100g)	30	49.27	75.7	60.70	0.058	0.10	0.160
Fat (g/100g)	30	22.88	36.94	30.88	0.039	0.13	0.108
Total nitrogen (g/100g)	30	19.36	33.63	24.89	0.045	0.18	0.125

Table 2: PROXIMATE repeatability criteria for dry matter, fat and total nitrogen in cheese samples²

For all criteria, the repeatability indicators (S_r and r) are significantly lower than the values of the reference standardised methods.

3.3 – Accuracy

The accuracy of the instrument was evaluated simultaneously with the repeatability evaluation, so with the same samples of cheese.

The accuracy was evaluated by comparing the mean of the results from the repeatability study and the results obtained with the reference standardised methods. There was no elimination of outliers in this statistical treatment.

	NIR Dry matter %	Ref Dry matter	NIR Fat %	Ref Fat	NIR Total nitrogen%	Ref Total nitrogen
n	30	30	30	30	30	30
min	49.29	49.84	22.90	22.75	19.37	19.82
max	75.15	73.36	33.59	36.38	33.59	32.50
M	60.70	60.76	30.88	31.12	24.89	24.98
Sx	5.36	5.14	3.73	3.60	2.74	2.63
d	-0.067		-0.238		-0.092	
Sd	0.521		0.563		0.656	
Sy,x	0.470		0.544		0.639	
Sy,x%	0.77%		1.75%		2.56%	
SEP	0.521		0.563		0.656	

² M: mean; S_r and S_R ($S_r\%$ and $S_R\%$): absolute and relative standard deviation of repeatability and reproducibility; r and R : maximum deviation of repeatability and reproducibility in 95 % of cases

RMSEP	0.517	0.603	0.652
b	0.955	0.952	0.931
a	2.797	1.706	1.806

Table 3: Proximate accuracy criteria for dry matter, fat and total nitrogen in cheese samples ³

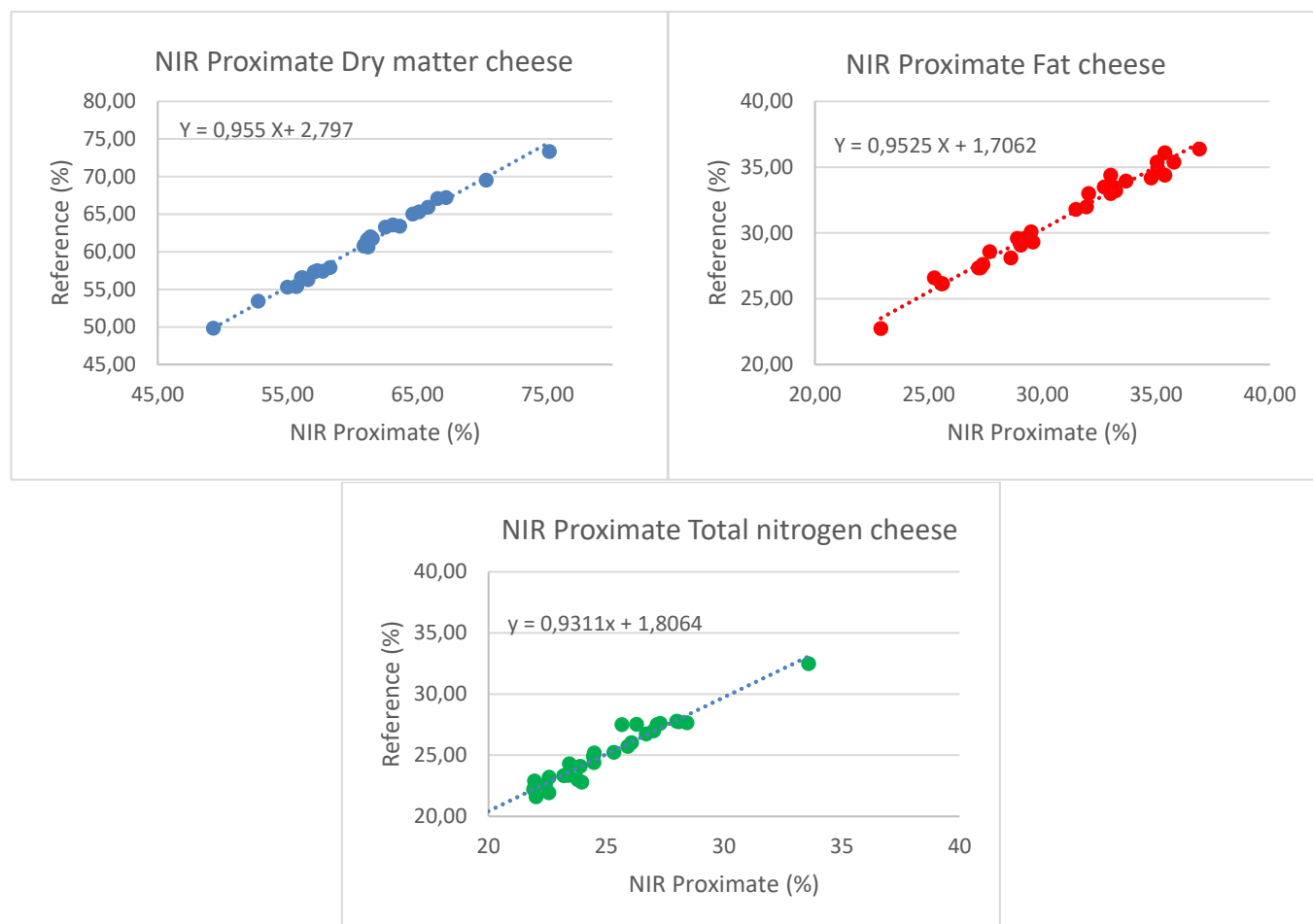


Figure 1: Relation between Proximate and reference method for dry matter, fat and total nitrogen in cheese

It can be noted the following performances by criterion:

- For dry matter, the prediction standard deviation is equal to 0.521 g/100 g, corresponding to an estimation precision of ± 1.04 g/100 g in 95 % of cases. The observed mean bias is low (-0.07 g/100 g).
- For fat, the prediction standard deviation is equal to 0.563 g/100 g, corresponding to an estimation precision of ± 1.12 g/100 g in 95 % of cases. The observed mean bias is relatively low (-0.24 g/100 g).
- For total nitrogen, the prediction standard deviation is equal to 0.656 g/100 g, corresponding to an estimation precision of ± 1.31 g/100 g. The observed mean bias is low (-0.09 g/100 g).

4. CONCLUSION

The conclusions of the various tests realised on the Buchi Proximate instrument are:

- Concerning repeatability, the instrument presents significantly lower repeatability standard deviation than the reference methods,
- Concerning accuracy, the prediction models evaluated present estimation accuracies of ± 1.04 g/100 g for dry matter, ± 1.12 g/100 g for fat and ± 1.31 g/100 g for total nitrogen, respectively.

All the results of this evaluation allow to conclude that the Proximate instrument complied with the requirements of the standards used.

According to the evaluation report of the Buchi NIR Proximate – Philippe TROOSAT – May 2025

³ n, min, max: number of results, minimum and maximum values; M, Sx: Mean and standard deviation of the values; d, Sd: mean and standard deviation of deviations; Sy,x, Sy,x%: absolute (and relative) residual standard deviation; SEP and RMSEP: prediction standard deviation and et root mean square error of prediction; b and a: slope and intercept of the simple linear regression