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**A community-built calibration system: The case study of quantification of metabolites in grape juice by qNMR spectroscopy**

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## Supplementary Data

### Community-built calibration system: the case study of metabolites quantification in grape juice by qNMR spectroscopy

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## Materials.

3-(Trimethylsilyl)-2,2,3,3-tetradeuteropropionic acid sodium salt (TSP, CAS N. 24493-21-8, 99 %D, Armar Chemicals, Döttingen, Switzerland), sodium azide ( $\text{NaN}_3$ , CAS N. 26628-22-8;  $\geq 99.5\%$ , Sigma-Aldrich, Milan, Italy), deuterium oxide ( $\text{D}_2\text{O}$ , CAS. N. 7789-20-0, 99.86 %D, Eurisotop, Saclay, France) and methanol- $d_4$  ( $\text{CD}_3\text{OD}$ , CAS. N. 811-98-3, 99.80 %D, Eurisotop, Saclay, France) were used for sample preparation. NMR tubes (Norell 509-UP 7) were provided by Norell, Landisville NJ, US. The NMR samples were prepared using the automated system for liquid handling (SamplePro Tube, Bruker BioSpin).

Wine grape samples (*cv.* Primitivo; Centro di Ricerca, Sperimentazione e Formazione in Agricoltura "Basile-Caramia (CRSFA), Locorotondo, Bari, Italy) were collected according to official recommendations (Regulations (CE) n. 834/2007, n. 889/2008, n. 1235/2008 and following modifications). 50 samples of *cv.* Primitivo were collected as follows: 30 berries were harvested randomly from different parts of the same plant for each sample. The samples were labelled according to the plant of origin, which was marked with a number and a letter, indicating respectively the vine-row and the sector of the vine-row to which the plant belonged. 1 bigger sample (1 Kg) was collected randomly from 3 plants belonging to the vineyard and labelled according to the same procedure. The samples were refrigerated at  $4^\circ\text{C}$  and transferred from the field to the laboratory, where they were stored at  $-20^\circ\text{C}$ .

## Experimental procedure.

The interlaboratory comparison was organized according to EN ISO/IEC 17043:2010 and reference normative therein (Conformity assessment - General requirements for proficiency testing) with 52 registered participants, 76 available spectrometers of which 65 producing results spectrometers [300, 400, 500, 600 and 700 MHz; Bruker (52), Agilent (9) and Jeol (4) manufacturers]. 75 sets of 8 NMR tubes were delivered to the participants and 65 spectrometers returned NMR data. The ILC participants were furnished with eight test NMR tubes, labelled as T, A, B, C, D, E, X, including a sample containing *cv.* Primitivo (tube X), and five test tubes (A – E) containing spiked solutions of four metabolites naturally contained in the grape juice (glucose, fructose, arginine and alanine). Tube T contained pure methanol- $d_4$  ( $\text{CD}_3\text{OD}$ , 99.80 %D) and was used as an NMR thermometer to calibrate the temperature of each spectrometer at  $298.1 \pm 0.1$  K. (Findeisen et al. 2007) Tube X, containing aqueous solutions of wine grape juice (*cv.* Primitivo), was prepared as follows: 10 berries were defrosted at room temperature for 60 minutes. They were mechanically pressed and the resulting grape juice ( $\sim 5$  ml) was centrifuged (Ettich Rotofix 32A, 2500 g, 15 minutes). The supernatant (1.08 ml) was combined with a solution (84.6 mg / 50 ml) of  $\text{NaN}_3$  in buffer  $[(\text{HC}_2\text{O}_4)^-]/(\text{C}_2\text{O}_4)^{2-}$  0.11 M, pH 4.2], giving Solution M1. 318 ml of this solution was combined stepwise with a volume of the buffer solution (222 ml) and a volume of a TSP/ $\text{D}_2\text{O}$  solution (60 mL, 0.10 g of TSP in 50 g of  $\text{D}_2\text{O}$ ). To reach the final levels of metabolites concentrations in the tubes A, B, C, D and E (figure 2), portions of the solution M1 prepared on big scale for the preparation of tube X were combined opportunely with the following two mixtures of metabolites in the buffer  $[(\text{HC}_2\text{O}_4)^-]/(\text{C}_2\text{O}_4)^{2-}$  0.11 M, pH 4.2]: solution M2 was composed of glucose ( $8.3\text{E}-01$  M), arginine

(1.43E-03 M), sodium malate (4.0E-02 M), sodium citrate (1.17E-03 M) and gamma aminobutyric acid (1.45E-04 M); solution M3 was composed of fructose (8.3E-02 M), tartaric acid (6.95E-04 M), alanine (1.68E-04 M) and threonine (1.26E-04 M).

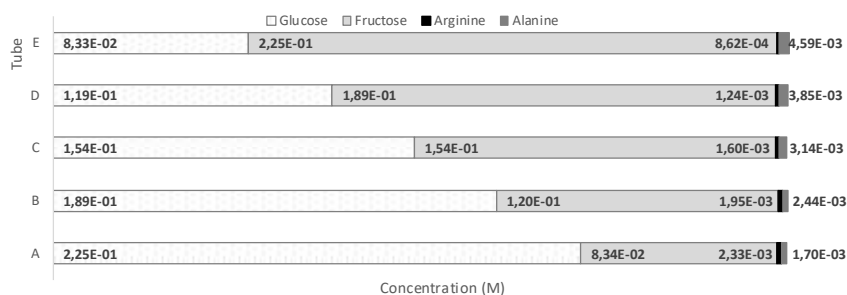


Figure S1. The final five levels of metabolites concentrations reached in the spiked solutions which are contained in tubes A – E.

### Data acquisition and processing.

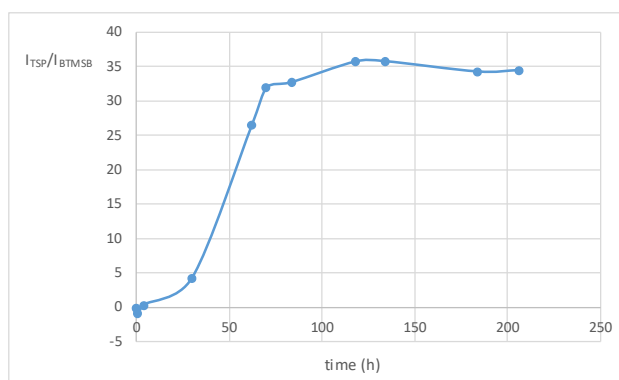
For each sample the participants were asked to perform five repetitions of a 1D 1H NOESY NMR experiment, preceded by a selective pre-saturation step to remove the residual water signal. The 5-fold replication was needed to comply with conditions for intermediate precision, i.e. same NMR tube, same spectrometer, same user, at least 24 h delay between runs, removal of the NMR tube from the magnet from run to run. The participants received experimental instructions for setting the acquisition parameters according to the spectrometer manufacturer requirements.

For Varian/Agilent spectrometers, guidelines included: pulse program (NOESY); size of fid (np, 128 K); spectral width (sw, 20 ppm); transmitter offset (tof): ca. 4.70 ppm (set the chemical shift value on the residual water signal); 90° hard pulse (pw, optimized by manual or automatic procedures keeping the pulse length as short as possible, preferably < 10 μs, if hardware allows it); steady state (ss, 8); number of transients (nt, 64); mixing time (mixN, 0.01 s); recycle delay (d1, 5 s); no sspul (sspul = 'n'); no ZQ filter (Gzqfilt = 'n'); no homo spoil during mixing time (gt1 = 0, gzlv11 = 0 and gstab = 0); presaturation during the whole length of d1, centered at the HDO residual signal with a nutation frequency of about 25 Hz [satmode = 'yn', satdly = d1, satfrq = tof; satpwr should be set to yield r1 of about 25 after running the command getpower(satpwr,tn):r1]; receiver gain optimization (once optimized for tube A, use the obtained receiver gain value also for all replicates and for all tubes A – E, X).

For Bruker spectrometers, guidelines included: pulse program: noesypr1d; size of FID (TD, 128 K); spectral width (SW, 20 ppm); transmitter offset, ca. 4.70 ppm (set at the chemical shift value of the residual water signal); 90° hard pulse (p1, optimized by manual or automatic procedures keeping the pulse length as short as possible, preferably < 10 μs, if hardware allows it); power level for presaturation (pl9, calculated by command “pulse 25Hz” after optimization of p1); dummy scans (ds, 8); number of scans (ns, 64); mixing time (d8, 0.01 s); recycle delay (d1, 5 s); receiver gain optimization (once optimized for tube A, use the obtained receiver gain value also for all replicates and for all tubes A – E, X).

For Jeol spectrometers, guidelines included: pulse program: noesy\_abs; y\_points = 1; size of fid (x\_point = 131072); spectral width (x\_sweep = 20); transmitter offset (x\_offset = 4.7); 90° hard pulse (x\_pulse = x90; x\_atn = xatn) to be optimized by manual or automatic procedures, keeping pulse length as short as possible, preferably < 10 μs; steady state (x\_prescans = 8); number of transients (scans = 64); mixing time (mix\_time = 0.01); recycle delay (relaxation\_delay = 5); presaturation during the whole length of recycle delay, centered at the HDO residual signal with a γB2 power of about 25 Hz (irr\_mode = presaturation; irr\_offset = x\_offset; presat\_time\_flag = y); use the following formula to calculate the value of irr\_attenuator corresponding to 25 Hz: irr\_attenuation = x\_atn + 20log(10.000/x90); receiver gain optimization (once optimized for tube A, use the obtained receiver gain value also for all replicates and for all tubes B-E, X and Y). The NMR raw data sets (FIDs and signal integrals) were uploaded by each laboratory on the website <http://nmr.mxcs.it/index.php> developed according to internationally agreed procedures. The NMR spectra could be re-processed Topspin 1.3 - AMIX 3.9.9 (Bruker BioSpin GmbH, Germany) and Mnova (Mestrelab Research, Spain). FID was zero-filled with 128 K number of points. FIDs were extended by zero-filling to a final size of 256 K. Fourier transformation was performed by applying an exponential multiplication function with a line broadening of 0.1 Hz. Users could choose to apply either manual or automatic procedures for the phase and the baseline correction (without any limitations provided that the same procedure is applied to all NMR spectra). The calculation of peak area was the only procedure accepted for the signal integration. The TSP singlet signal (0.00 ppm) was used as internal reference compound, upon ascertaining it was stable in solution over the time four days after the sample preparation. The integral of TSP signal was referred to the integral of 1,4-bis(trimethylsilyl)benzene (BTMSB) used as external reference compound (2.08 mg of BTMSB in 620 μl of 1,1,2,2-tetrachloroethane-*d*<sub>2</sub>).

time (h)	TSP	BTMSB	TSP/BTMSB
0	22865957,19	106502671	0,214698439
1	22692030	106662826,6	0,21274544
4	22349555,94	103727159,1	0,215464842
30	23446407,44	104751304,1	0,223829265
62	29709773,94	109437063,6	0,271478172
70	32117033,31	113384010,6	0,283258928
84	31644292,5	110999759,7	0,285084333
118	31888216,56	109401903,1	0,291477713
134	31874377,06	109292721,7	0,291642266
184	30892070,75	107131325,4	0,288357029
206	30679005,31	106215720,6	0,288836767





## Selection of spectra regions for signals integration

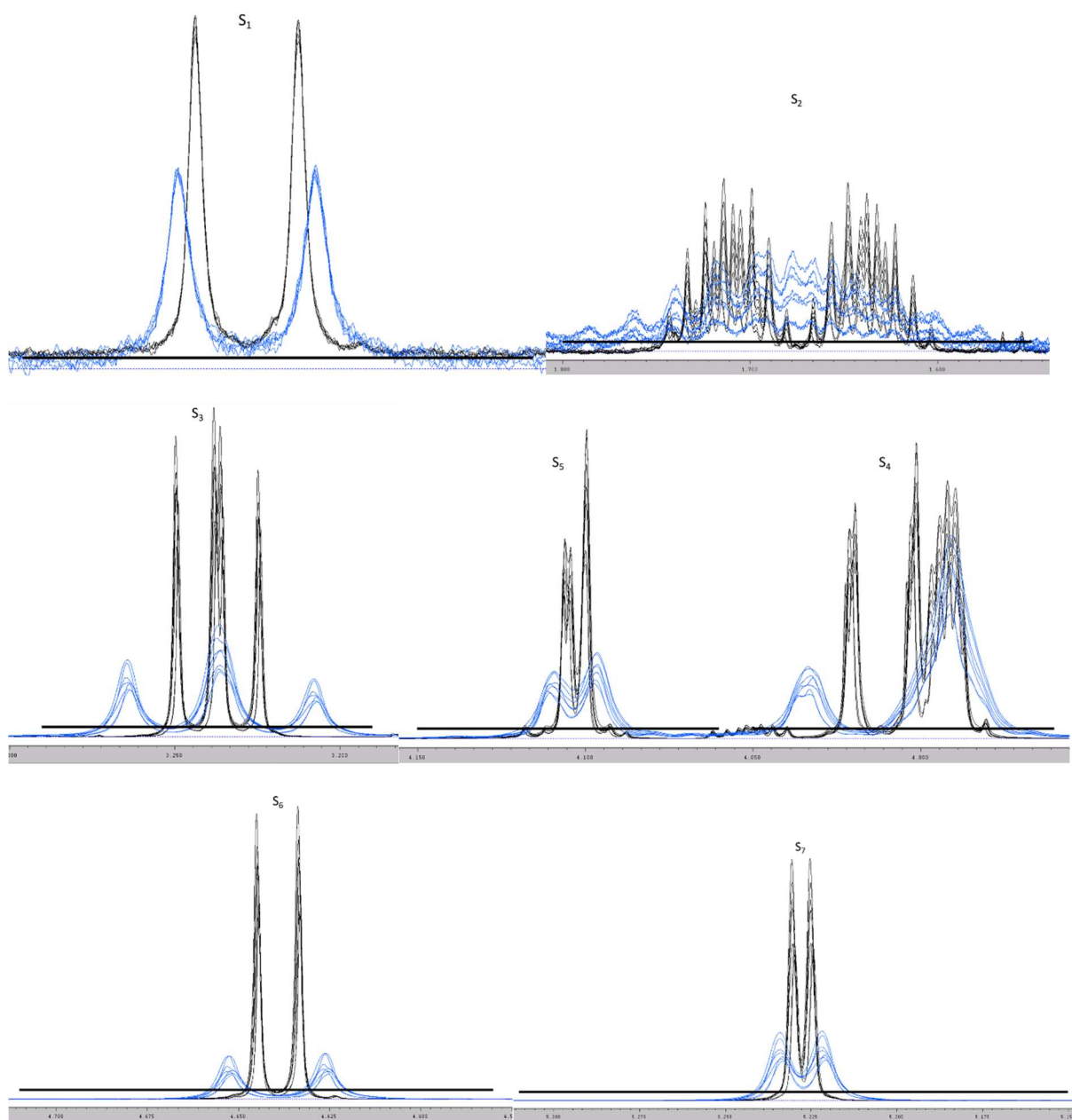


Figure S2. The regions of the spectra which were selected and integrated. For convenience are represented only the spectra of tubes A – E recorded by a 300 MHz spectrometer (blue spectra) and a 700 MHz spectrometer (black spectra).

## Application of ANOVA to test the linearity of the regression curves

- Example 1 (Laboratory 11 during the analysis of signal 1): accepted regression curve with P-value of F lower than alpha value (0.05).

<i>Statistic of regression</i>	
Multiple R	0.999090052
R Square	0.998180932
Adjusted R Square	0.998115965
Standard Error	0.018349051
Observations	30

ANOVA							
	<i>gdl</i>	<i>SQ</i>	<i>MQ</i>	<i>F (1-tail test)</i>	<i>P-value of F</i>	<i>Alpha</i>	<i>Linearity</i>
Regression	1	5.173036323	5.173036	15364.49595	6.49739E-40	0.05	accepted regression
Residual	28	0.009427255	0.000337				
Total	29	5.182463577					

- Example 2 (Laboratory 42 during the analysis of signal 1): rejected regression curve with P-value of F higher than alpha value (0.05).

<i>Statistic of Regression</i>	
Multiple R	0.219099
R Square	0.048004
Adjusted R Square	0.014005
Standard Error	2.946559
Observations	30

ANOVA							
	<i>gdl</i>	<i>SQ</i>	<i>MQ</i>	<i>F (1-tail test)</i>	<i>P-value of F</i>	<i>Alpha</i>	<i>Linearity</i>
Regression	1	12.25844	12.25844	1.411902929	0.244722052	0.05	rejected regression
Residual	28	243.1019	8.68221				
Total	29	255.3603					

## Application of ANCOVA to test the parallelism and the coincidence of the calibration curves with respect to the reference regression curve

The ANCOVA (ANalysis of COVariance) method was applied to test the parallelism of each selected line with respect to the *community-built reference line*. As an example, in figure S3 is represented the application of this approach to the case of the regression line produced by the spectrometer of laboratory 11 (red line) and the *reference line* (black dashed line). The average residual of the regression line of the spectrometer 11 and the reference regression line was calculated as  $[MS_{Pooled} = (RSS_{Lab11} + RSS_{Ref})/df]$ , where the  $MS_{Pooled}$  is the average Mean Square error of all the involved curves,  $RSS_{Lab11}$  and  $RSS_{Ref}$  are the residual sum of square of the regression line of the spectrometer 11 and of the reference regression line, respectively, and  $df$  is the degree of freedom calculated as  $n - 2$  ( $n$  = number of observations). A common regression line (yellow line, figure 4) was designed using the overall variables of the reference line and the regression line under analysis and an  $MS_{common}$  was calculated (see supporting material for further details). The average residual of the slopes was calculated as  $[MS_{Slopes} = (RSS_{common} - RSS_{Pooled})/df]$  where  $df$  is calculated, in this case, as  $n-1$  ( $n$  = number of lines which are compared). Next, the probability density for the one-tail F-distribution of the positive ratio  $F$  (calculated as  $[F = MS_{Regression\ Coefficient}/MS_{Pooled}]$ , when  $MS_{Slopes} > MS_{Pooled}$ , or as  $[F = MS_{Pooled}/MS_{Slopes}]$  when  $MS_{Slopes} < MS_{Pooled}$  and representing the degree of diversity between  $MS_{Pooled}$  and  $MS_{Slopes}$ ) was evaluated. Only the lines for which such test gave a probability higher than the alpha-value (0.025) defined as a threshold were considered parallel and admitted to the following step testing the coincidence of the  $y$ -intercept. A similar approach as described for T4 – parallelism test was used in T5 – coincidence test. For this purpose, the degree of freedom of the common regression model was increased of one unit, giving a new regression model which was called total. Then, the  $MS_{y-intercept}$ , which represented the average difference in the  $y$ -intercepts between the line under investigation and the *community-built reference line*, was calculated as  $[(RSS_{total} - RSS_{common})/df]$ , where  $df$  was given by  $n-1$  ( $n$  = number of lines which are compared). Analogously to the parallelism test, the probability density for the one-tail F-distribution of  $F$  was evaluated (T5 – coincidence) for the remaining 34 regression lines. In this case,  $F$  was calculated as either  $F = MS_{y-intercept}/MS_{Common}$ , when  $MS_{y-intercept} > MS_{Common}$ , or  $F = MS_{Common}/MS_{y-intercept}$ , when  $MS_{y-intercept} < MS_{Common}$ . Only the lines for which such test gave a probability higher than the alpha-value (0.025) defined as a threshold were considered coincident (see supporting material for further details).

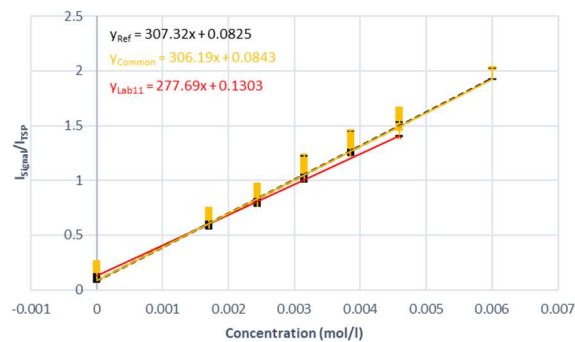


Figure S3. Application of the consecutive tests verifying the coincidence of the slopes and the elevations between the regression line produced by the spectrometer 11 and the reference line designed using all the data produced by the laboratories which were preliminarily assessed as suitable for analyte quantification. The common line (yellow line) represents the line designed using both the variables of the reference line (black dashed line) and the line under quality assessment (red line).

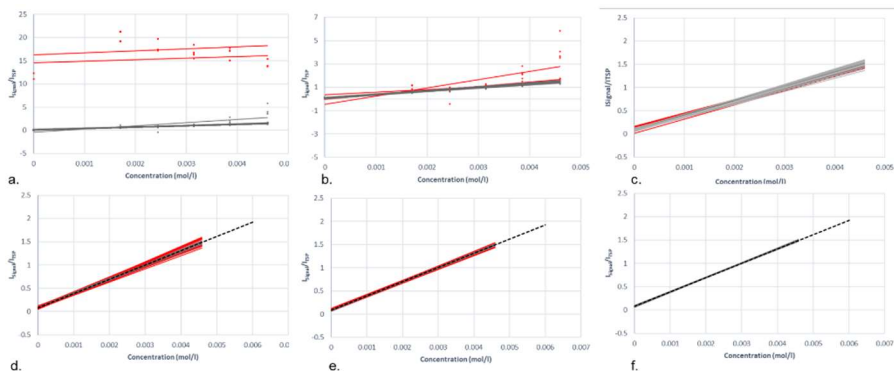
- Example: Laboratory 11 during the analysis of signal 1.

Observations	X	Y							
1	0.001699674	0.60050798							
2	0.001699674	0.59621622							
3	0.001699674	0.59736326							
4	0.001699674	0.6							
5	0.001699674	0.59960763							
6	0.0024362	0.78852682							
7	0.0024362	0.79344486							
8	0.0024362	0.79406751							
9	0.0024362	0.79213293							
10	0.0024362	0.78876329							
11	0.003144398	1.01577238							
12	0.003144398	1.02876002							
13	0.003144398	1.02214598							
14	0.003144398	1.02431754							
15	0.003144398	1.01668486							
16	0.003852596	1.21366794							
17	0.003852596	1.2313476							
18	0.003852596	1.22362385							
19	0.003852596	1.22827497							
20	0.003852596	1.23001443							
21	0.004589121	1.37900753							
22	0.004589121	1.37638427							
23	0.004589121	1.38662589							
24	0.004589121	1.3836296							
25	0.004589121	1.37730943							
26	0	0.1327818							
27	0	0.13177891							
28	0	0.12871597							
29	0	0.12895479							
30	0	0.12795564							
Identification	n (observations)	SX	SY	SX^2	SY^2	SXY	Mean X	Mean Y	
1 Laboratory 11	30	0.078609945	25.73838	0.000273	27.26461	0.086072	0.002620332	0.85794613	
2 Reference curve	1620	4.24493703	1434.182	0.014746	1611.8773	4.867452	0.002620332	0.88529768	
number of curves	2								
Total	1650	4.323546975	1459.921	0.015019	1639.1419	4.953524			
ANCOVA									
	df	SdX2	SdXdY	SdY2	slope (b)	Residual SS	MS	y-Intercept	
1 Laboratory 11	28	6.70845E-05	0.018629	5.182464	277.69086	0.009427	0.000336688	0.13030403	
2 Reference curve	1618	0.003622564	1.109419	342.1991	306.25243	2.436786	0.001506048	0.08281479	
Pooled curve	1646						2.446214	0.001486156	
Reg. Coef.	1						0.05373	0.053730099	
Common	1647	0.003689649	1.128048	347.3816	305.73313	2.499944	0.001517877		
Adj. Means	1						0.022035	0.022035162	
Total	1648	0.003689649	1.128048	347.4036	305.73313	2.521979	0.001530327		
		numerator denominator							
	F (2-tails test)	df	df	P	Alpha	Decision			
H0: Slopes equal	36.15372964	1	1646	2.242E-09	0.025	Not Parallel			
H0: Elevations equal	14.51709174	1	1647	0.000144	0.025	Not Coincident			

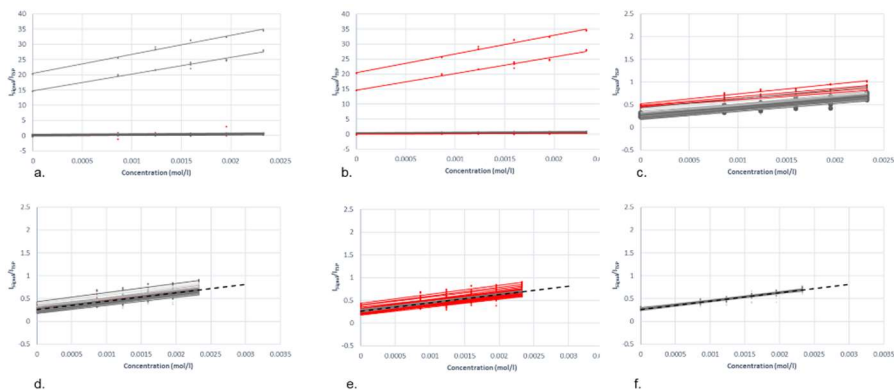
## Selection of the regression curves produced by the ILC participants.

Plots of the regression curves produced for the signals 1 - 7 during the sequence of selection tests. a. linearity test; b. Huber and Cochran tests on slopes; c. Huber and Cochran tests on intercepts; d. parallelism test on slopes; e. coincidence tests on elevations; f. final suitable regression lines for quantification purposes. Black curves passed successfully the selection test; red lines failed the selection test; black dashed line represents the reference regression curve.

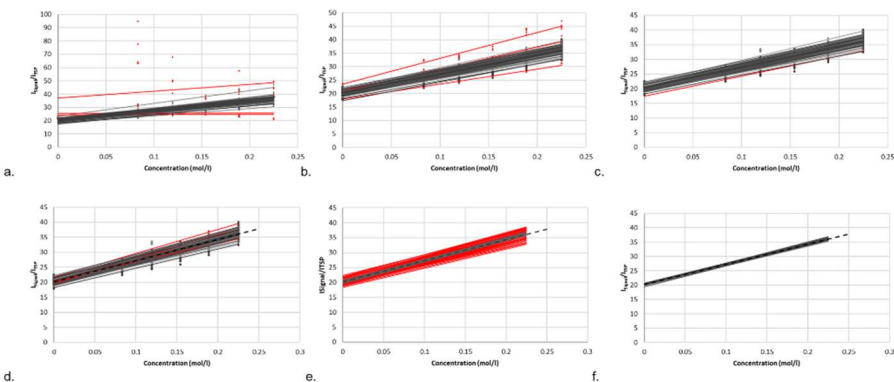
### Signal S1 [1.42, 1.51 ppm]: alanine



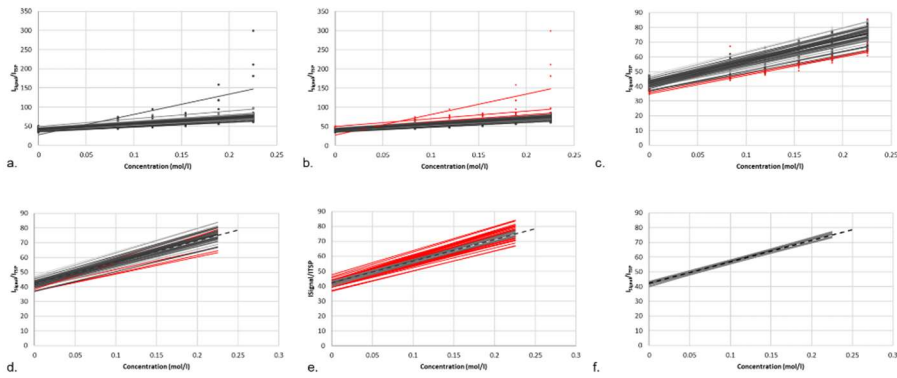
### Signal S2 [1.55, 1.80 ppm]: arginine



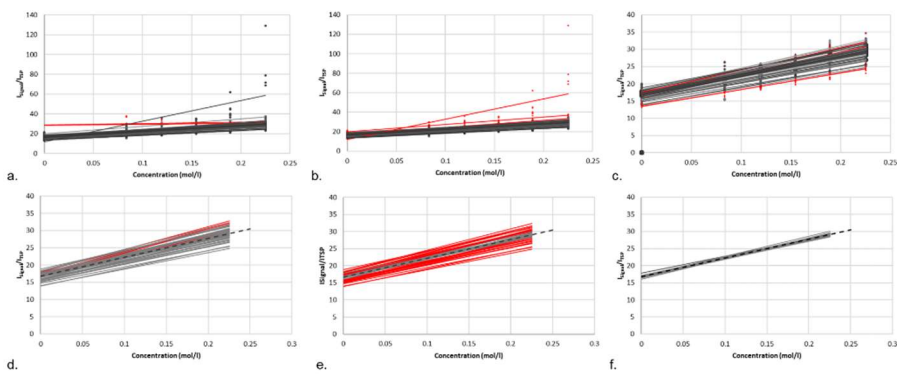
### Signal S3 [3.19, 3.29 ppm]: glucose



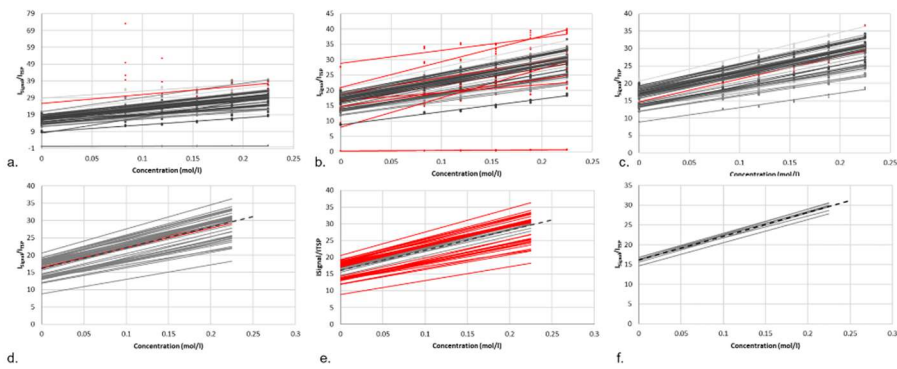
### Signal S4 [3.96, 4.05 ppm]: fructose



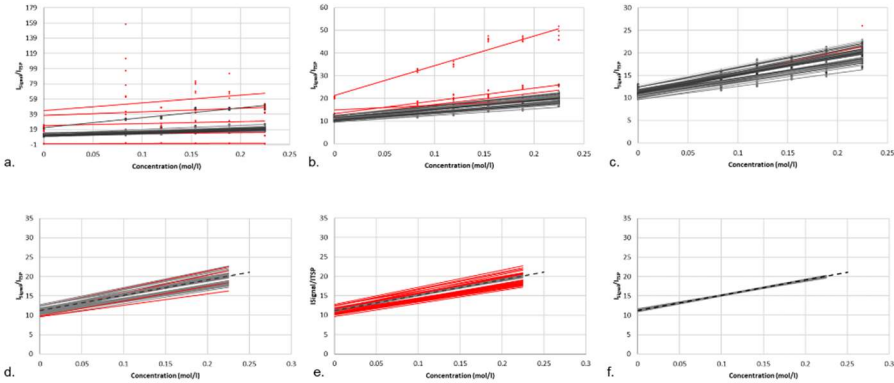
### Signal S5 [4.06, 4.15 ppm]: fructose



### Signal S6 [4.58, 4.71 ppm]: glucose



Signal S7 [5.15, 5.31 ppm]: glucose





**Table S1. qNMR analysis of alanine (S1)**

Selection process applied to the calibration curves produced by the ILC participants for the qNMR analysis of alanine (S1 at 1.42 - 1.51 ppm).

Spectrometer	F test for linearity	Huber-Cochran tests on slopes	Huber-Cochran tests on y-intercepts	Parallelism test	Coincidence test
1 Bruker 400, 2006	OK	OK	outlier	outlier	outlier
2 Varian 500, 2002	OK	OK	OK	OK	OK
3 Varian 700, 2005	OK	OK	OK	outlier	outlier
4 Bruker 600, 2006	OK	OK	OK	outlier	outlier
5 Bruker 600, 2007	OK	OK	OK	OK	outlier
6 Bruker 500, 2016	OK	OK	OK	outlier	outlier
7 Bruker 400, 2002	OK	OK	OK	outlier	outlier
8 Bruker 500, 2014	OK	OK	OK	OK	outlier
9 Bruker 400, 2010	OK	OK	OK	outlier	outlier
10 Bruker 600, 2010	OK	OK	OK	OK	OK
11 Bruker 400, 2013	OK	OK	OK	outlier	outlier
12 Bruker 500, 2016	OK	OK	OK	OK	OK
13 Bruker 600, 1999	OK	OK	OK	OK	OK
14 Bruker 600, 2007	OK	OK	OK	OK	OK
15 Bruker 600, 2014	OK	OK	OK	OK	OK
16 Bruker 400, 2003	OK	OK	OK	OK	OK
17 Bruker 600, 2014	OK	OK	OK	OK	outlier
18 Bruker 600, 2014	OK	OK	OK	outlier	outlier
19 Bruker 600, 2009	OK	OK	OK	OK	outlier
20 Bruker 400, 2010	OK	OK	outlier	outlier	outlier
21 Bruker 600, 1998	OK	OK	OK	outlier	outlier
22 Bruker 400, 2014	OK	OK	OK	OK	OK
23 Bruker 700, 2010	OK	OK	OK	outlier	outlier
24 Bruker 500, 1987	OK	OK	OK	OK	OK
25 Bruker 400, 2003	OK	OK	outlier	outlier	outlier
26 Bruker 600, 2006	OK	outlier	outlier	outlier	outlier
27 Agilent 600, 2001	OK	outlier	outlier	outlier	outlier
28 Bruker 400, 2010	OK	outlier	outlier	outlier	outlier
29 Bruker 400, 2013	OK	OK	OK	OK	OK
30 Bruker 500, 2000	OK	OK	OK	OK	OK
31 Bruker 700, 2006	OK	OK	OK	OK	OK
32 Bruker 500, 2001	OK	OK	OK	OK	OK
33 Bruker 400, 2000	OK	OK	OK	outlier	outlier
34 Agilent 500, 2008	OK	OK	OK	OK	outlier
35 Bruker 400, 2009	OK	OK	OK	OK	OK
36 Bruker 600, 1991	OK	OK	OK	OK	OK
37 Bruker 500, 2014	OK	OK	OK	OK	outlier
38 Varian 400, 1997	OK	OK	outlier	outlier	outlier
39 Agilent 500, 2014	OK	OK	OK	OK	OK
40 Agilent 500, 2014	OK	OK	OK	OK	OK
41 Bruker 500, 2004	OK	OK	OK	OK	OK
42 Bruker 700, 2001	outlier	outlier	outlier	outlier	outlier
43 Bruker 400, 2015	OK	OK	OK	outlier	outlier
44 Jeol 600, 2016	OK	OK	OK	outlier	outlier
45 Bruker 600, 2007	OK	OK	OK	outlier	outlier
46 Bruker 500, 2014	OK	OK	OK	OK	outlier
47 Bruker 500, 2014	OK	OK	OK	outlier	outlier
48 Bruker 400, 2005	outlier	outlier	outlier	outlier	outlier
49 Bruker 500, 2017	OK	OK	OK	OK	OK
50 Bruker 400, 2016	OK	OK	OK	OK	OK
51 Bruker 500, 2010	OK	OK	OK	outlier	outlier
52 Bruker 400, 2011	OK	OK	OK	outlier	outlier
53 Agilent 500, 2015	OK	OK	OK	OK	OK
54 Bruker 400, 2016	OK	OK	OK	OK	outlier
55 Bruker 500, 2004	OK	OK	OK	OK	OK
56 Bruker 700, 2013	OK	OK	OK	outlier	outlier
57 Bruker 400, 2012	OK	OK	outlier	outlier	outlier
58 Varian 400, 2013	OK	outlier	outlier	outlier	outlier
59 Bruker 400, 2015	OK	OK	OK	OK	OK
60 Jeol 600, 2016	OK	OK	OK	OK	outlier
61 Bruker 300, 2001	OK	OK	OK	outlier	outlier
62 Bruker 600, 2016	OK	OK	OK	OK	OK
63 Jeol 600, 2016	OK	OK	OK	OK	OK
64 Jeol 300, 2000	OK	OK	OK	outlier	outlier
65 Bruker 400, 2012	OK	OK	OK	outlier	outlier

n: 63 59 54 34 25

**Table S2. qNMR analysis of arginine (S2)**

Selection process applied to the calibration curves produced by the ILC participants for the qNMR analysis of arginine (S2 at 1.55 - 1.80 ppm).

Spectrometer	F test for linearity	Huber-Cochran tests on slopes	Huber-Cochran tests on y-intercepts	Parallelism test	Coincidence test
1 Bruker 400, 2006	OK	OK	OK	OK	outlier
2 Varian 500, 2002	OK	OK	OK	OK	OK
3 Varian 700, 2005	OK	OK	OK	OK	OK
4 Bruker 600, 2006	OK	OK	OK	OK	OK
5 Bruker 600, 2007	OK	OK	OK	OK	OK
6 Bruker 500, 2016	OK	OK	OK	OK	outlier
7 Bruker 400, 2002	OK	OK	OK	OK	outlier
8 Bruker 500, 2014	OK	OK	OK	OK	outlier
9 Bruker 400, 2010	OK	OK	OK	OK	outlier
10 Bruker 600, 2010	OK	OK	OK	OK	OK
11 Bruker 400, 2013	OK	OK	OK	OK	outlier
12 Bruker 500, 2016	OK	OK	OK	OK	OK
13 Bruker 600, 1999	OK	OK	OK	OK	outlier
14 Bruker 600, 2007	OK	OK	OK	OK	outlier
15 Bruker 600, 2014	OK	OK	OK	OK	outlier
16 Bruker 400, 2003	OK	OK	OK	OK	outlier
17 Bruker 600, 2014	OK	outlier	outlier	outlier	outlier
18 Bruker 600, 2014	OK	OK	OK	OK	outlier
19 Bruker 600, 2009	OK	OK	OK	OK	outlier
20 Bruker 400, 2010	OK	OK	outlier	outlier	outlier
21 Bruker 600, 1998	OK	OK	OK	OK	OK
22 Bruker 400, 2014	OK	OK	OK	OK	outlier
23 Bruker 700, 2010	OK	OK	OK	OK	outlier
24 Bruker 500, 1987	OK	OK	OK	OK	OK
25 Bruker 400, 2003	OK	OK	outlier	outlier	outlier
26 Bruker 600, 2006	OK	OK	OK	OK	outlier
27 Agilent 600, 2001	OK	outlier	outlier	outlier	outlier
28 Bruker 400, 2010	OK	OK	outlier	outlier	outlier
29 Bruker 400, 2013	OK	OK	OK	OK	outlier
30 Bruker 500, 2000	OK	OK	OK	OK	OK
31 Bruker 700, 2006	OK	OK	OK	OK	outlier
32 Bruker 500, 2001	OK	OK	OK	OK	OK
33 Bruker 400, 2000	OK	OK	OK	OK	outlier
34 Agilent 500, 2008	OK	OK	outlier	outlier	outlier
35 Bruker 400, 2009	OK	OK	OK	OK	OK
36 Bruker 600, 1991	OK	OK	OK	OK	outlier
37 Bruker 500, 2014	OK	OK	OK	OK	outlier
38 Varian 400, 1997	OK	outlier	outlier	outlier	outlier
39 Agilent 500, 2014	OK	OK	OK	OK	OK
40 Agilent 500, 2014	OK	outlier	outlier	outlier	outlier
41 Bruker 500, 2004	OK	OK	OK	OK	OK
42 Bruker 700, 2001	OK	outlier	outlier	outlier	outlier
43 Bruker 400, 2015	OK	OK	OK	OK	OK
44 Jeol 600, 2016	OK	outlier	outlier	outlier	outlier
45 Bruker 600, 2007	OK	OK	OK	OK	OK
46 Bruker 500, 2014	OK	OK	OK	OK	outlier
47 Bruker 500, 2014	OK	OK	OK	OK	outlier
48 Bruker 400, 2005	OK	outlier	outlier	outlier	outlier
49 Bruker 500, 2017	OK	OK	OK	OK	outlier
50 Bruker 400, 2016	OK	OK	OK	OK	outlier
51 Bruker 500, 2010	OK	OK	OK	OK	OK
52 Bruker 400, 2011	OK	outlier	outlier	outlier	outlier
53 Agilent 500, 2015	OK	OK	OK	OK	OK
54 Bruker 400, 2016	OK	OK	OK	OK	outlier
55 Bruker 500, 2004	OK	OK	OK	OK	OK
56 Bruker 700, 2013	OK	outlier	outlier	outlier	outlier
57 Bruker 400, 2012	OK	outlier	outlier	outlier	outlier
58 Varian 400, 2013	OK	outlier	outlier	outlier	outlier
59 Bruker 400, 2015	OK	OK	OK	OK	OK
60 Jeol 600, 2016	OK	OK	OK	OK	outlier
61 Bruker 300, 2001	OK	OK	OK	OK	outlier
62 Bruker 600, 2016	OK	OK	OK	OK	outlier
63 Jeol 600, 2016	OK	OK	OK	OK	OK
64 Jeol 300, 2000	OK	outlier	outlier	outlier	outlier
65 Bruker 400, 2012	OK	OK	OK	OK	outlier

n | 65 | 53 | 49 | 49 | 20

**Table S3. qNMR analysis of glucose (S3)**

Selection process applied to the calibration curves produced by the ILC participants for the qNMR analysis of glucose (S3 at 3.19 - 3.29 ppm).

Spectrometer	F test for linearity	Huber-Cochran tests on slopes	Huber-Cochran tests on y -intercepts	Parallelism test	Coincidence test
1 Bruker 400, 2006	OK	OK	OK	OK	outlier
2 Varian 500, 2002	OK	OK	OK	OK	outlier
3 Varian 700, 2005	OK	OK	OK	OK	outlier
4 Bruker 600, 2006	OK	OK	OK	OK	outlier
5 Bruker 600, 2007	OK	OK	OK	OK	outlier
6 Bruker 500, 2016	OK	OK	OK	OK	outlier
7 Bruker 400, 2002	OK	OK	OK	OK	outlier
8 Bruker 500, 2014	OK	OK	OK	outlier	outlier
9 Bruker 400, 2010	OK	OK	OK	OK	outlier
10 Bruker 600, 2010	OK	OK	OK	OK	outlier
11 Bruker 400, 2013	OK	OK	OK	OK	outlier
12 Bruker 500, 2016	OK	OK	OK	OK	OK
13 Bruker 600, 1999	OK	OK	OK	OK	outlier
14 Bruker 600, 2007	OK	OK	OK	OK	OK
15 Bruker 600, 2014	OK	OK	OK	OK	OK
16 Bruker 400, 2003	OK	OK	OK	OK	outlier
17 Bruker 600, 2014	OK	OK	OK	OK	outlier
18 Bruker 600, 2014	OK	OK	OK	OK	outlier
19 Bruker 600, 2009	OK	OK	OK	OK	OK
20 Bruker 400, 2010	OK	OK	OK	OK	outlier
21 Bruker 600, 1998	OK	OK	OK	OK	OK
22 Bruker 400, 2014	OK	OK	OK	OK	outlier
23 Bruker 700, 2010	OK	OK	OK	outlier	outlier
24 Bruker 500, 1987	OK	OK	OK	OK	OK
25 Bruker 400, 2003	OK	OK	OK	OK	outlier
26 Bruker 600, 2006	OK	OK	OK	OK	outlier
27 Agilent 600, 2001	OK	outlier	outlier	outlier	outlier
28 Bruker 400, 2010	OK	outlier	outlier	outlier	outlier
29 Bruker 400, 2013	OK	OK	OK	OK	outlier
30 Bruker 500, 2000	OK	OK	OK	OK	OK
31 Bruker 700, 2006	OK	OK	OK	outlier	outlier
32 Bruker 500, 2001	OK	OK	OK	OK	outlier
33 Bruker 400, 2000	OK	OK	OK	OK	outlier
34 Agilent 500, 2008	OK	OK	OK	OK	outlier
35 Bruker 400, 2009	OK	OK	OK	OK	OK
36 Bruker 600, 1991	OK	OK	OK	OK	OK
37 Bruker 500, 2014	OK	OK	OK	OK	outlier
38 Varian 400, 1997	OK	outlier	outlier	outlier	outlier
39 Agilent 500, 2014	OK	OK	OK	OK	outlier
40 Agilent 500, 2014	OK	OK	OK	OK	OK
41 Bruker 500, 2004	OK	OK	OK	OK	outlier
42 Bruker 700, 2001	outlier	outlier	outlier	outlier	outlier
43 Bruker 400, 2015	OK	OK	OK	OK	outlier
44 Jeol 600, 2016	OK	OK	OK	OK	outlier
45 Bruker 600, 2007	OK	OK	OK	OK	OK
46 Bruker 500, 2014	OK	OK	OK	OK	outlier
47 Bruker 500, 2014	OK	OK	OK	OK	outlier
48 Bruker 400, 2005	outlier	outlier	outlier	outlier	outlier
49 Bruker 500, 2017	OK	OK	OK	outlier	outlier
50 Bruker 400, 2016	OK	OK	OK	OK	outlier
51 Bruker 500, 2010	OK	OK	OK	OK	OK
52 Bruker 400, 2011	OK	OK	OK	OK	outlier
53 Agilent 500, 2015	OK	OK	OK	OK	OK
54 Bruker 400, 2016	OK	OK	OK	outlier	outlier
55 Bruker 500, 2004	OK	OK	OK	OK	OK
56 Bruker 700, 2013	OK	OK	OK	OK	outlier
57 Bruker 400, 2012	OK	OK	OK	OK	OK
58 Varian 400, 2013	outlier	outlier	outlier	outlier	outlier
59 Bruker 400, 2015	OK	OK	OK	outlier	outlier
60 Jeol 600, 2016	OK	OK	OK	OK	outlier
61 Bruker 300, 2001	OK	OK	outlier	outlier	outlier
62 Bruker 600, 2016	OK	OK	OK	OK	OK
63 Jeol 600, 2016	OK	OK	OK	OK	OK
64 Jeol 300, 2000	OK	OK	OK	OK	outlier
65 Bruker 400, 2012	OK	OK	OK	OK	outlier

n | 62 | 59 | 58 | 52 | 17

**Table S4. qNMR analysis of fructose (S4)**

Selection process applied to the calibration curves produced by the ILC participants for the qNMR analysis of fructose (S4 at 3.96 - 4.05 ppm).

Spectrometer	F test for linearity	Huber-Cochran tests on slopes	Huber-Cochran tests on y-intercepts	Parallelism test	Coincidence test
1 Bruker 400, 2006	OK	OK	OK	OK	outlier
2 Varian 500, 2002	OK	OK	OK	OK	outlier
3 Varian 700, 2005	OK	OK	OK	OK	outlier
4 Bruker 600, 2006	OK	OK	OK	OK	outlier
5 Bruker 600, 2007	OK	OK	OK	OK	outlier
6 Bruker 500, 2016	OK	OK	OK	OK	OK
7 Bruker 400, 2002	OK	OK	OK	OK	outlier
8 Bruker 500, 2014	OK	OK	OK	OK	OK
9 Bruker 400, 2010	OK	OK	OK	OK	outlier
10 Bruker 600, 2010	OK	OK	OK	OK	outlier
11 Bruker 400, 2013	OK	OK	OK	outlier	outlier
12 Bruker 500, 2016	OK	OK	OK	OK	OK
13 Bruker 600, 1999	OK	OK	OK	OK	outlier
14 Bruker 600, 2007	OK	OK	OK	OK	outlier
15 Bruker 600, 2014	OK	OK	OK	OK	OK
16 Bruker 400, 2003	OK	OK	OK	OK	OK
17 Bruker 600, 2014	OK	OK	OK	OK	outlier
18 Bruker 600, 2014	OK	OK	OK	outlier	outlier
19 Bruker 600, 2009	OK	OK	OK	OK	outlier
20 Bruker 400, 2010	OK	OK	OK	OK	outlier
21 Bruker 600, 1998	OK	OK	OK	OK	OK
22 Bruker 400, 2014	OK	OK	OK	OK	outlier
23 Bruker 700, 2010	OK	OK	OK	OK	outlier
24 Bruker 500, 1987	OK	OK	OK	OK	OK
25 Bruker 400, 2003	OK	OK	OK	OK	outlier
26 Bruker 600, 2006	OK	outlier	outlier	outlier	outlier
27 Agilent 600, 2001	OK	outlier	outlier	outlier	outlier
28 Bruker 400, 2010	OK	OK	OK	outlier	outlier
29 Bruker 400, 2013	OK	OK	OK	OK	outlier
30 Bruker 500, 2000	OK	OK	OK	OK	OK
31 Bruker 700, 2006	OK	OK	OK	OK	outlier
32 Bruker 500, 2001	OK	OK	OK	OK	OK
33 Bruker 400, 2000	OK	OK	OK	OK	outlier
34 Agilent 500, 2008	OK	OK	OK	OK	OK
35 Bruker 400, 2009	OK	OK	OK	OK	OK
36 Bruker 600, 1991	OK	OK	OK	OK	OK
37 Bruker 500, 2014	OK	OK	OK	outlier	outlier
38 Varian 400, 1997	OK	OK	outlier	outlier	outlier
39 Agilent 500, 2014	OK	OK	OK	OK	outlier
40 Agilent 500, 2014	OK	OK	OK	OK	outlier
41 Bruker 500, 2004	OK	OK	OK	OK	outlier
42 Bruker 700, 2001	OK	OK	OK	OK	outlier
43 Bruker 400, 2015	OK	OK	OK	OK	outlier
44 Jeol 600, 2016	OK	OK	OK	OK	OK
45 Bruker 600, 2007	OK	OK	OK	OK	outlier
46 Bruker 500, 2014	OK	OK	OK	OK	outlier
47 Bruker 500, 2014	OK	OK	OK	OK	outlier
48 Bruker 400, 2005	OK	OK	OK	OK	OK
49 Bruker 500, 2017	OK	OK	OK	OK	outlier
50 Bruker 400, 2016	OK	OK	OK	outlier	outlier
51 Bruker 500, 2010	OK	OK	OK	OK	outlier
52 Bruker 400, 2011	OK	OK	OK	OK	outlier
53 Agilent 500, 2015	OK	OK	OK	OK	OK
54 Bruker 400, 2016	OK	OK	OK	OK	OK
55 Bruker 500, 2004	OK	OK	OK	OK	OK
56 Bruker 700, 2013	OK	OK	OK	OK	outlier
57 Bruker 400, 2012	OK	OK	OK	OK	OK
58 Varian 400, 2013	OK	outlier	outlier	outlier	outlier
59 Bruker 400, 2015	OK	OK	OK	OK	OK
60 Jeol 600, 2016	OK	OK	OK	OK	outlier
61 Bruker 300, 2001	OK	OK	outlier	outlier	outlier
62 Bruker 600, 2016	OK	OK	OK	OK	OK
63 Jeol 600, 2016	OK	OK	OK	OK	OK
64 Jeol 300, 2000	OK	OK	outlier	outlier	outlier
65 Bruker 400, 2012	OK	OK	OK	OK	OK

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**Table S5. qNMR analysis of fructose (S5)**

Selection process applied to the calibration curves produced by the ILC participants for the qNMR analysis of fructose (S5 at 4.06 - 4.15 ppm).

Spectrometer	F test for linearity	Huber-Cochran tests on slopes	Huber-Cochran tests on y-intercepts	Parallelism test	Coincidence test
1 Bruker 400, 2006	OK	OK	OK	OK	outlier
2 Varian 500, 2002	OK	OK	OK	OK	outlier
3 Varian 700, 2005	OK	OK	OK	OK	outlier
4 Bruker 600, 2006	OK	OK	OK	OK	outlier
5 Bruker 600, 2007	OK	OK	OK	OK	OK
6 Bruker 500, 2016	OK	OK	OK	OK	outlier
7 Bruker 400, 2002	OK	OK	OK	OK	outlier
8 Bruker 500, 2014	OK	OK	OK	OK	OK
9 Bruker 400, 2010	OK	OK	OK	OK	outlier
10 Bruker 600, 2010	OK	OK	OK	OK	outlier
11 Bruker 400, 2013	OK	OK	OK	OK	outlier
12 Bruker 500, 2016	OK	OK	OK	OK	outlier
13 Bruker 600, 1999	OK	OK	OK	OK	outlier
14 Bruker 600, 2007	OK	OK	OK	outlier	outlier
15 Bruker 600, 2014	OK	OK	OK	OK	outlier
16 Bruker 400, 2003	OK	OK	OK	OK	outlier
17 Bruker 600, 2014	OK	OK	OK	outlier	outlier
18 Bruker 600, 2014	OK	OK	OK	OK	outlier
19 Bruker 600, 2009	OK	OK	OK	OK	OK
20 Bruker 400, 2010	OK	OK	OK	OK	outlier
21 Bruker 600, 1998	OK	OK	OK	OK	OK
22 Bruker 400, 2014	OK	OK	OK	OK	OK
23 Bruker 700, 2010	OK	OK	OK	OK	outlier
24 Bruker 500, 1987	OK	OK	OK	OK	OK
25 Bruker 400, 2003	OK	OK	OK	OK	outlier
26 Bruker 600, 2006	OK	OK	OK	outlier	outlier
27 Agilent 600, 2001	OK	outlier	outlier	outlier	outlier
28 Bruker 400, 2010	OK	OK	OK	OK	outlier
29 Bruker 400, 2013	OK	OK	OK	OK	OK
30 Bruker 500, 2000	OK	OK	OK	OK	OK
31 Bruker 700, 2006	OK	OK	OK	OK	outlier
32 Bruker 500, 2001	OK	OK	OK	outlier	outlier
33 Bruker 400, 2000	OK	OK	OK	OK	outlier
34 Agilent 500, 2008	OK	OK	OK	OK	outlier
35 Bruker 400, 2009	OK	OK	OK	OK	OK
36 Bruker 600, 1991	OK	OK	OK	OK	OK
37 Bruker 500, 2014	OK	OK	OK	OK	outlier
38 Varian 400, 1997	OK	OK	outlier	outlier	outlier
39 Agilent 500, 2014	OK	OK	OK	OK	outlier
40 Agilent 500, 2014	OK	OK	OK	outlier	outlier
41 Bruker 500, 2004	OK	OK	OK	OK	outlier
42 Bruker 700, 2001	outlier	outlier	outlier	outlier	outlier
43 Bruker 400, 2015	OK	OK	OK	OK	outlier
44 Jeol 600, 2016	OK	OK	OK	OK	outlier
45 Bruker 600, 2007	OK	OK	OK	OK	OK
46 Bruker 500, 2014	OK	OK	OK	OK	outlier
47 Bruker 500, 2014	OK	OK	OK	OK	outlier
48 Bruker 400, 2005	outlier	outlier	outlier	outlier	outlier
49 Bruker 500, 2017	OK	OK	OK	OK	OK
50 Bruker 400, 2016	OK	OK	outlier	outlier	outlier
51 Bruker 500, 2010	OK	outlier	outlier	outlier	outlier
52 Bruker 400, 2011	OK	OK	OK	OK	outlier
53 Agilent 500, 2015	OK	OK	OK	OK	OK
54 Bruker 400, 2016	OK	OK	OK	OK	OK
55 Bruker 500, 2004	OK	OK	OK	OK	OK
56 Bruker 700, 2013	OK	OK	OK	OK	outlier
57 Bruker 400, 2012	OK	OK	OK	OK	outlier
58 Varian 400, 2013	OK	outlier	outlier	outlier	outlier
59 Bruker 400, 2015	OK	OK	OK	OK	OK
60 Jeol 600, 2016	OK	OK	OK	OK	outlier
61 Bruker 300, 2001	OK	OK	outlier	outlier	outlier
62 Bruker 600, 2016	OK	OK	OK	OK	outlier
63 Jeol 600, 2016	OK	OK	OK	OK	OK
64 Jeol 300, 2000	OK	OK	outlier	outlier	outlier
65 Bruker 400, 2012	OK	OK	OK	OK	OK

n | 63 | 60 | 56 | 51 | 18

**Table S6. qNMR analysis of glucose (S6)**

Selection process applied to the calibration curves produced by the ILC participants for the qNMR analysis of glucose (S6 at 4.58 - 4.71 ppm).

Spectrometer	F test for linearity	Huber-Cochran tests on slopes	Huber-Cochran tests on y-intercepts	Parallelism test	Coincidence test
1 Bruker 400, 2006	OK	OK	OK	OK	outlier
2 Varian 500, 2002	OK	OK	OK	OK	outlier
3 Varian 700, 2005	OK	OK	OK	OK	outlier
4 Bruker 600, 2006	OK	OK	OK	OK	outlier
5 Bruker 600, 2007	OK	OK	OK	outlier	outlier
6 Bruker 500, 2016	OK	outlier	outlier	outlier	outlier
7 Bruker 400, 2002	OK	OK	OK	OK	outlier
8 Bruker 500, 2014	OK	OK	OK	OK	outlier
9 Bruker 400, 2010	OK	OK	OK	OK	outlier
10 Bruker 600, 2010	OK	OK	OK	OK	outlier
11 Bruker 400, 2013	OK	OK	OK	OK	outlier
12 Bruker 500, 2016	OK	OK	OK	OK	outlier
13 Bruker 600, 1999	OK	OK	OK	OK	outlier
14 Bruker 600, 2007	OK	OK	OK	OK	outlier
15 Bruker 600, 2014	OK	OK	OK	OK	outlier
16 Bruker 400, 2003	OK	OK	OK	OK	OK
17 Bruker 600, 2014	OK	OK	OK	OK	outlier
18 Bruker 600, 2014	OK	OK	OK	OK	outlier
19 Bruker 600, 2009	OK	OK	OK	OK	outlier
20 Bruker 400, 2010	OK	OK	OK	OK	outlier
21 Bruker 600, 1998	OK	OK	OK	OK	outlier
22 Bruker 400, 2014	OK	OK	OK	OK	outlier
23 Bruker 700, 2010	OK	OK	OK	OK	outlier
24 Bruker 500, 1987	OK	OK	OK	OK	OK
25 Bruker 400, 2003	OK	OK	OK	OK	outlier
26 Bruker 600, 2006	OK	OK	OK	OK	outlier
27 Agilent 600, 2001	OK	outlier	outlier	outlier	outlier
28 Bruker 400, 2010	OK	OK	OK	OK	outlier
29 Bruker 400, 2013	OK	OK	OK	OK	outlier
30 Bruker 500, 2000	OK	OK	OK	OK	OK
31 Bruker 700, 2006	OK	OK	OK	OK	outlier
32 Bruker 500, 2001	OK	OK	OK	OK	OK
33 Bruker 400, 2000	OK	OK	OK	OK	outlier
34 Agilent 500, 2008	OK	OK	OK	OK	outlier
35 Bruker 400, 2009	OK	OK	OK	OK	outlier
36 Bruker 600, 1991	OK	OK	OK	OK	outlier
37 Bruker 500, 2014	OK	OK	OK	OK	outlier
38 Varian 400, 1997	OK	OK	outlier	outlier	outlier
39 Agilent 500, 2014	OK	OK	OK	OK	OK
40 Agilent 500, 2014	OK	OK	OK	OK	outlier
41 Bruker 500, 2004	OK	outlier	outlier	outlier	outlier
42 Bruker 700, 2001	OK	outlier	outlier	outlier	outlier
43 Bruker 400, 2015	OK	OK	OK	OK	outlier
44 Jeol 600, 2016	OK	OK	OK	OK	outlier
45 Bruker 600, 2007	OK	OK	OK	OK	outlier
46 Bruker 500, 2014	OK	OK	OK	OK	OK
47 Bruker 500, 2014	OK	OK	OK	OK	OK
48 Bruker 400, 2005	OK	outlier	outlier	outlier	outlier
49 Bruker 500, 2017	OK	outlier	outlier	outlier	outlier
50 Bruker 400, 2016	OK	outlier	outlier	outlier	outlier
51 Bruker 500, 2010	OK	OK	OK	OK	outlier
52 Bruker 400, 2011	OK	outlier	outlier	outlier	outlier
53 Agilent 500, 2015	OK	OK	OK	outlier	outlier
54 Bruker 400, 2016	OK	OK	OK	OK	outlier
55 Bruker 500, 2004	OK	OK	OK	OK	outlier
56 Bruker 700, 2013	OK	OK	OK	OK	outlier
57 Bruker 400, 2012	OK	OK	OK	OK	outlier
58 Varian 400, 2013	outlier	outlier	outlier	outlier	outlier
59 Bruker 400, 2015	OK	OK	OK	OK	OK
60 Jeol 600, 2016	OK	OK	OK	OK	outlier
61 Bruker 300, 2001	OK	OK	OK	OK	outlier
62 Bruker 600, 2016	OK	OK	OK	OK	outlier
63 Jeol 600, 2016	OK	OK	OK	OK	outlier
64 Jeol 300, 2000	OK	OK	OK	OK	OK
65 Bruker 400, 2012	OK	outlier	outlier	outlier	outlier

n | 64 | 55 | 54 | 52 | 9

**Table S7. qNMR analysis of glucose (S7)**

Selection process applied to the calibration curves produced by the ILC participants for the qNMR analysis of glucose (S7 at 5.15 - 5.31 ppm).

Spectrometer	F test for linearity	Huber-Cochran tests on slopes	Huber-Cochran tests on y-intercepts	Parallelism test	Coincidence test
1 Bruker 400, 2006	OK	OK	OK	OK	outlier
2 Varian 500, 2002	OK	OK	OK	OK	outlier
3 Varian 700, 2005	OK	OK	OK	OK	outlier
4 Bruker 600, 2006	OK	OK	OK	OK	outlier
5 Bruker 600, 2007	OK	OK	OK	OK	outlier
6 Bruker 500, 2016	outlier	outlier	outlier	outlier	outlier
7 Bruker 400, 2002	OK	OK	OK	OK	outlier
8 Bruker 500, 2014	OK	OK	OK	OK	OK
9 Bruker 400, 2010	OK	OK	OK	OK	outlier
10 Bruker 600, 2010	OK	OK	OK	OK	outlier
11 Bruker 400, 2013	OK	OK	OK	OK	outlier
12 Bruker 500, 2016	OK	outlier	outlier	outlier	outlier
13 Bruker 600, 1999	OK	OK	OK	OK	outlier
14 Bruker 600, 2007	OK	OK	OK	OK	OK
15 Bruker 600, 2014	OK	OK	OK	OK	OK
16 Bruker 400, 2003	OK	OK	OK	outlier	outlier
17 Bruker 600, 2014	outlier	outlier	outlier	outlier	outlier
18 Bruker 600, 2014	OK	OK	OK	OK	OK
19 Bruker 600, 2009	OK	OK	OK	OK	outlier
20 Bruker 400, 2010	OK	OK	OK	OK	outlier
21 Bruker 600, 1998	OK	OK	OK	OK	OK
22 Bruker 400, 2014	OK	OK	OK	OK	outlier
23 Bruker 700, 2010	OK	OK	OK	outlier	outlier
24 Bruker 500, 1987	OK	OK	OK	outlier	outlier
25 Bruker 400, 2003	OK	OK	OK	OK	outlier
26 Bruker 600, 2006	OK	OK	OK	OK	outlier
27 Agilent 600, 2001	OK	outlier	outlier	outlier	outlier
28 Bruker 400, 2010	OK	OK	OK	outlier	outlier
29 Bruker 400, 2013	OK	OK	OK	OK	outlier
30 Bruker 500, 2000	OK	OK	OK	OK	OK
31 Bruker 700, 2006	OK	OK	OK	OK	outlier
32 Bruker 500, 2001	OK	OK	OK	OK	outlier
33 Bruker 400, 2000	outlier	outlier	outlier	outlier	outlier
34 Agilent 500, 2008	OK	OK	OK	OK	OK
35 Bruker 400, 2009	OK	OK	OK	OK	outlier
36 Bruker 600, 1991	OK	OK	OK	OK	outlier
37 Bruker 500, 2014	OK	OK	OK	OK	outlier
38 Varian 400, 1997	OK	OK	outlier	outlier	outlier
39 Agilent 500, 2014	OK	OK	OK	OK	outlier
40 Agilent 500, 2014	OK	OK	OK	OK	outlier
41 Bruker 500, 2004	OK	OK	OK	OK	outlier
42 Bruker 700, 2001	outlier	outlier	outlier	outlier	outlier
43 Bruker 400, 2015	OK	OK	OK	OK	outlier
44 Jeol 600, 2016	OK	OK	OK	OK	outlier
45 Bruker 600, 2007	OK	OK	OK	OK	outlier
46 Bruker 500, 2014	OK	OK	OK	OK	OK
47 Bruker 500, 2014	OK	OK	OK	OK	OK
48 Bruker 400, 2005	outlier	outlier	outlier	outlier	outlier
49 Bruker 500, 2017	OK	OK	OK	outlier	outlier
50 Bruker 400, 2016	OK	outlier	outlier	outlier	outlier
51 Bruker 500, 2010	OK	OK	OK	OK	outlier
52 Bruker 400, 2011	OK	OK	OK	OK	OK
53 Agilent 500, 2015	OK	OK	OK	OK	OK
54 Bruker 400, 2016	OK	OK	OK	OK	outlier
55 Bruker 500, 2004	OK	OK	OK	OK	outlier
56 Bruker 700, 2013	OK	OK	OK	OK	outlier
57 Bruker 400, 2012	OK	outlier	outlier	outlier	outlier
58 Varian 400, 2013	outlier	outlier	outlier	outlier	outlier
59 Bruker 400, 2015	OK	OK	OK	OK	outlier
60 Jeol 600, 2016	OK	OK	OK	OK	OK
61 Bruker 300, 2001	OK	OK	OK	outlier	outlier
62 Bruker 600, 2016	OK	OK	OK	OK	OK
63 Jeol 600, 2016	OK	OK	OK	OK	OK
64 Jeol 300, 2000	OK	OK	OK	OK	outlier
65 Bruker 400, 2012	OK	OK	OK	OK	outlier
n	59	55	54	48	14





**Table S8. Performance of the selected laboratories for the qNMR analysis of S1 – S7**

For each repeatable predicted concentration (according to Huber-Cochran tests) is reported the corresponding z-score value (acceptable values in green, questionable values in orange). n.r. not repeatable predicted concentration according to Huber-Cochran tests. N, number of metabolite concentrations which resulted reproducible for each laboratory. N, number of predicted concentrations which resulted reproducible for each metabolite during the interlaboratory comparison. PRSD, predicted relative standard deviation according to the Horwitz equation. RSD, relative standard deviation for each metabolite calculated considering the predicted concentrations which resulted repeatable according to the Huber-Cochran tests. HorRat, Horwitz ratio as  $RSD\%/PRSD\%$ .

Spectrometer	Parallel curves							n	Coincident curves							n
	S1	S2	S3	S4	S5	S6	S7		S1	S2	S3	S4	S5	S6	S7	
1 Bruker 400, 2006	n.r.	2.26	-0.82	2.17	1.63	-1.24	-0.50	6	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
2 Varian 500, 2002	-0.31	0.05	0.46	0.43	0.38	0.38	-0.20	7	-0.27	0.27	n.r.	n.r.	n.r.	n.r.	n.r.	2
3 Varian 700, 2005	n.r.	-0.42	0.64	0.57	0.41	0.33	-0.48	6	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
4 Bruker 600, 2006	n.r.	-0.23	0.30	-0.75	-0.51	0.77	0.02	6	n.r.	-0.46	n.r.	n.r.	n.r.	n.r.	n.r.	1
5 Bruker 600, 2007	-0.36	n.r.	0.54	-0.42	0.84	n.r.	-1.54	5	n.r.	n.r.	n.r.	n.r.	0.75	n.r.	n.r.	1
6 Bruker 500, 2016	n.r.	1.26	-0.61	0.62	-1.38	n.r.	n.r.	4	n.r.	n.r.	n.r.	0.60	n.r.	n.r.	n.r.	1
7 Bruker 400, 2002	n.r.	0.44	-0.80	1.83	1.37	-0.26	-0.40	6	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
8 Bruker 500, 2014	-0.16	-1.20	n.r.	1.77	1.51	0.13	-0.84	6	n.r.	n.r.	n.r.	1.71	1.59	n.r.	-0.18	2
9 Bruker 400, 2010	n.r.	-0.43	0.80	0.87	0.35	-0.88	0.46	6	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
10 Bruker 600, 2010	-1.29	-0.30	n.r.	-1.06	-0.44	1.91	1.69	6	-1.30	-0.65	n.r.	n.r.	n.r.	n.r.	n.r.	2
11 Bruker 400, 2013	n.r.	2.42	0.81	n.r.	1.38	-0.94	1.70	5	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
12 Bruker 500, 2016	0.18	-0.46	-0.39	-0.58	-1.00	-0.35	n.r.	6	0.26	n.r.	-1.31	-0.58	n.r.	n.r.	n.r.	3
13 Bruker 600, 1999	-2.04	n.r.	0.16	0.73	0.43	0.30	-0.26	6	-2.10	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	1
14 Bruker 600, 2007	0.23	0.50	1.12	-0.18	n.r.	0.87	-0.18	6	0.31	n.r.	1.54	n.r.	n.r.	n.r.	1.14	2
15 Bruker 600, 2014	0.95	0.27	-0.31	-0.64	-1.67	0.56	-0.61	7	1.08	n.r.	-1.16	-0.63	n.r.	n.r.	n.r.	3
16 Bruker 400, 2003	-1.19	-1.23	0.00	-0.11	1.27	-1.16	n.r.	6	-1.19	n.r.	n.r.	-0.11	n.r.	-1.11	n.r.	3
17 Bruker 600, 2014	0.11	n.r.	-0.29	-1.38	n.r.	0.69	n.r.	4	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
18 Bruker 600, 2014	n.r.	0.64	n.r.	n.r.	-1.96	2.04	2.06	4	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
19 Bruker 600, 2009	0.93	0.74	0.05	0.24	0.76	1.89	0.30	7	n.r.	n.r.	-0.48	n.r.	0.65	n.r.	n.r.	2
20 Bruker 400, 2010	n.r.	n.r.	1.97	0.79	0.50	-0.64	0.97	5	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
21 Bruker 600, 1998	n.r.	-0.18	0.33	-0.86	-0.72	0.66	-0.32	6	n.r.	-0.33	0.04	-0.85	-1.22	n.r.	0.85	4
22 Bruker 400, 2014	0.86	0.55	1.30	0.60	0.41	-1.20	1.14	7	0.98	n.r.	n.r.	n.r.	0.20	n.r.	n.r.	2
23 Bruker 700, 2010	n.r.	-0.69	n.r.	-0.47	-0.45	0.30	n.r.	4	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
24 Bruker 500, 1987	0.89	0.89	0.17	1.18	1.08	-0.29	n.r.	6	1.01	2.45	n.r.	1.14	1.06	0.59	n.r.	5
25 Bruker 400, 2003	n.r.	n.r.	0.13	-0.41	-0.75	-0.80	-0.53	5	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
26 Bruker 600, 2006	n.r.	1.22	n.r.	n.r.	n.r.	2.33	2.19	3	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
27 Agilent 600, 2001	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
28 Bruker 400, 2010	n.r.	n.r.	n.r.	n.r.	n.r.	-0.51	n.r.	1	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
29 Bruker 400, 2013	1.57	0.52	0.72	0.40	0.07	-0.95	0.47	7	1.73	n.r.	n.r.	n.r.	-0.22	n.r.	n.r.	2
30 Bruker 500, 2000	0.34	-0.03	-0.19	0.14	-0.09	-0.37	-0.50	7	0.42	0.05	-0.95	0.12	-0.42	0.43	0.50	6
31 Bruker 700, 2006	-1.46	0.09	n.r.	-1.02	-0.99	0.27	-1.63	6	-1.49	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	1
32 Bruker 500, 2001	-0.19	-0.11	-1.26	0.72	n.r.	-0.89	-1.32	6	-0.13	-0.16	n.r.	0.69	n.r.	-0.59	n.r.	4
33 Bruker 400, 2000	n.r.	-0.56	0.22	-0.14	0.38	-0.64	n.r.	5	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
34 Agilent 500, 2008	2.82	n.r.	0.78	-0.19	-0.42	1.66	1.58	6	n.r.	n.r.	n.r.	-0.19	n.r.	n.r.	n.r.	1
35 Bruker 400, 2009	-0.49	n.r.	0.98	0.13	0.00	-0.77	0.49	6	-0.46	n.r.	1.26	0.12	-0.31	n.r.	n.r.	4
36 Bruker 600, 1991	0.75	2.46	0.21	0.87	0.89	0.90	0.62	7	0.87	n.r.	-0.19	0.84	0.81	n.r.	n.r.	4
37 Bruker 500, 2014	-1.11	-1.26	-0.66	n.r.	-0.51	0.58	0.95	6	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
38 Varian 400, 1997	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
39 Agilent 500, 2014	0.57	-0.62	-1.31	0.83	0.61	-0.23	-0.94	7	0.67	-1.47	n.r.	n.r.	n.r.	0.71	n.r.	3
40 Agilent 500, 2014	n.r.	n.r.	-1.84	-1.05	n.r.	0.65	0.46	4	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
41 Bruker 500, 2004	0.29	0.11	-0.78	0.52	-0.02	n.r.	-0.87	6	0.38	0.42	n.r.	n.r.	n.r.	n.r.	n.r.	2
42 Bruker 700, 2001	n.r.	n.r.	n.r.	-1.43	n.r.	n.r.	n.r.	1	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
43 Bruker 400, 2015	n.r.	-0.40	0.76	0.60	0.33	-0.91	0.52	6	n.r.	-0.92	n.r.	n.r.	n.r.	n.r.	n.r.	1
44 Jeol 600, 2016	n.r.	n.r.	-0.04	0.84	-0.02	0.72	-0.11	5	n.r.	n.r.	n.r.	0.81	n.r.	n.r.	n.r.	1
45 Bruker 600, 2007	n.r.	-0.55	0.74	-1.23	-0.74	0.27	-0.48	6	n.r.	-1.28	0.80	n.r.	-1.24	n.r.	n.r.	3
46 Bruker 500, 2014	-0.45	-0.89	n.r.	-0.52	-0.46	-0.95	-1.51	6	n.r.	n.r.	n.r.	n.r.	n.r.	-0.70	-1.53	1
47 Bruker 500, 2014	n.r.	-0.90	-1.55	-1.12	-1.14	-1.12	-1.35	6	n.r.	n.r.	n.r.	n.r.	n.r.	-1.02	-1.20	1
48 Bruker 400, 2005	n.r.	n.r.	n.r.	-2.73	n.r.	n.r.	n.r.	1	n.r.	n.r.	n.r.	-2.67	n.r.	n.r.	n.r.	1
49 Bruker 500, 2017	0.05	-0.84	n.r.	1.61	n.r.	n.r.	n.r.	3	0.12	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	1
50 Bruker 400, 2016	-1.64	-1.57	-0.82	n.r.	n.r.	n.r.	n.r.	3	-1.67	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	1
51 Bruker 500, 2010	n.r.	2.05	-2.16	1.07	n.r.	-0.55	-0.66	5	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
52 Bruker 400, 2011	n.r.	n.r.	1.25	-1.54	2.54	n.r.	2.09	4	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
53 Agilent 500, 2015	0.56	-0.15	-0.32	0.61	0.80	n.r.	-0.59	6	0.66	-0.27	-1.18	0.58	0.70	n.r.	0.32	5
54 Bruker 400, 2016	n.r.	-1.18	n.r.	-1.22	-2.14	-0.17	0.83	5	n.r.	n.r.	n.r.	-1.20	n.r.	n.r.	n.r.	1
55 Bruker 500, 2004	0.36	0.05	0.29	0.72	0.50	0.27	0.10	7	0.45	0.27	-0.04	0.69	0.33	n.r.	n.r.	5
56 Bruker 700, 2013	n.r.	n.r.	1.23	0.21	-0.22	1.01	-0.39	5	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
57 Bruker 400, 2012	n.r.	n.r.	-2.37	0.86	0.05	-2.20	n.r.	4	n.r.	n.r.	n.r.	0.83	n.r.	n.r.	n.r.	1
58 Varian 400, 2013	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
59 Bruker 400, 2015	0.70	0.35	n.r.	0.49	0.71	0.27	0.30	6	0.81	1.05	n.r.	0.47	0.59	1.69	n.r.	5
60 Jeol 600, 2016	-0.28	-0.56	-2.10	-0.99	-1.80	-0.11	-1.34	7	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	-1.18	0
61 Bruker 300, 2001	n.r.	-1.44	n.r.	n.r.	n.r.	-2.41	n.r.	2	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
62 Bruker 600, 2016	-1.02	-1.03	0.98	-0.03	0.26	-0.15	-0.70	7	-1.01	n.r.	1.26	-0.04	n.r.	n.r.	0.10	3
63 Jeol 600, 2016	-0.18	0.35	0.52	-1.04	-0.91	0.75	-0.15	7	-0.12	1.04	0.40	-1.02	-1.46	n.r.	1.19	5
64 Jeol 300, 2000	n.r.	n.r.	-0.34	n.r.	n.r.	0.21	-0.55	3	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	0
65 Bruker 400, 2012	n.r.	n.r.	1.50	-1.33	-1.18	n.r.	n.r.	3	n.r.	n.r.	n.r.	-1.31	-1.80	n.r.	n.r.	2
N	32	45	48	54	49	52	47		24	15	13	22	16	8	10	
PRSD%	10.01	7.04	3.15	3.16	3.12	3.19	3.16		10.01	7.04	3.15	3.16	3.12	3.19	3.16	
RSD%	17.39	20.88	3.12	5.17	5.78	10.56	5.48		16.55	8.14	1.64	5.30	4.51	5.77	2.87	
HorRat	1.74	2.97	0.99	1.64	1.85	3.31	1.73		1.65	1.16	0.52	1.68	1.44	1.81	0.91	