Use of NIR spectroscopy to improve sampling for sensory QDA?

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Introduction

One major difficulty when performing **quantitative descriptive sensory analyses (QDA)** with unprocessed natural products is their inherent **heterogeneity**. It is essential to find methods for selecting representative and heterogeneous samples in order to optimize quality of analyses. This study assessed the use of **non-destructive near-infrared spectroscopy (NIRS)** with pears as a model food. Six varieties were measured with NIRS to predict sugar content of single fruits. Reference method measurements (refractometry, titration and penetrometry) were performed for the same fruits. Specific objectives were the following:

i) determination of how many measurements are needed to obtain a sample of e.g. 10 fruits within ±0.5 °Brix around the median at a confidence level of α=.90 (Fig. 1)
ii) to check if a selection based on NIRS °Brix prediction also leads to a sample more homogenous in terms of acidity and firmness compared to random selection
iii) determination of how much panel precision and accuracy can be improved using this method (Table 1)

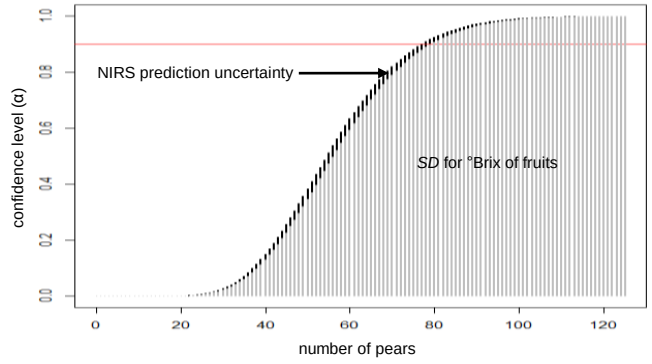

Fig. 1: Simulation based on collected data to determine how many fruits are needed to obtain a sample of e.g. 10 fruits within ±0.5 °Brix at a confidence level of α=.90.

Results

i) To obtain a sample of 10 fruits within ±0.5 °Brix a total of 79 fruits need to be measured in a worst-case scenario using the highest *SD*=2.26 and lowest correlation (*R*=.84) between NIRS model and reference measurements (Fig. 1).
ii) Correlations between °Brix, acidity and firmness were weak and not consistent throughout varieties. Only slight improvements can be expected for homogeneity of acidity and firmness when selecting fruits according to °Brix predictions.
iii) Table 1 shows that there were no consistent improvements in panel precision and accuracy since the variability in panel performance might have been bigger than the effect of a more homogenous sample. Observable improvements could be expected when doing more replications.

Table 1: Difference in panel (*N*=11) precision and accuracy between random selected samples and NIRS selected samples. Positive values (blue) represent improvements and negative values (red) deteriorations.

	pear variety	overall flavor intensity	fruity	green	floral	spices	lactic	sweet	sour	astringent	biter	firm	crunchy	granular	melting	juicy	chewy	sustaining aroma
Precision	ACW 3851	-0.16	-0.84	1.32	-0.55	0.27	0.03	-0.25	-0.78	-0.17	-0.06	0.16	0.89	0.40	0.82	-2.27	0.40	0.38
	Conference	0.24	-0.46	-0.17	-1.38	2.43	-1.03	0.04	1.46	0.30	1.04	-0.48	1.14	0.00	0.43	-0.38	-1.57	-0.66
Accuracy	ACW 3851	0.56	0.48	0.26	-0.22	-0.56	0.22	0.02	0.37	0.11	0.78	-0.67	-1.02	-0.16	-0.8	-0.36	-0.17	-1.34
	Conference	-0.77	-0.31	-0.8	-0.37	-0.85	0.05	-0.27	0.59	0.36	0.09	0.85	0.93	0.54	0.96	-0.21	-0.37	-0.68

Note. Panel precision as the root-square replication reliability difference and panel accuracy as the standard deviation difference of single attributes.

Conclusion

NIR spectroscopy seems to be a **suitable and promising** method to improve sample homogeneity (although this is only valid for °Brix) and **optimize panel performance** when dealing with unprocessed natural foods. To quantify improvements in panel precision and accuracy for single attributes, further assessments are needed. Additionally this method could be used in **panel training** to offer samples with **specific characteristics** (°Brix values).

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