Prediction of Soluble Solids Content in Intact Sugar Beet: A Preliminary Study for a Fiber-Optic Probe Sensor.

Financé par :

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Introduction

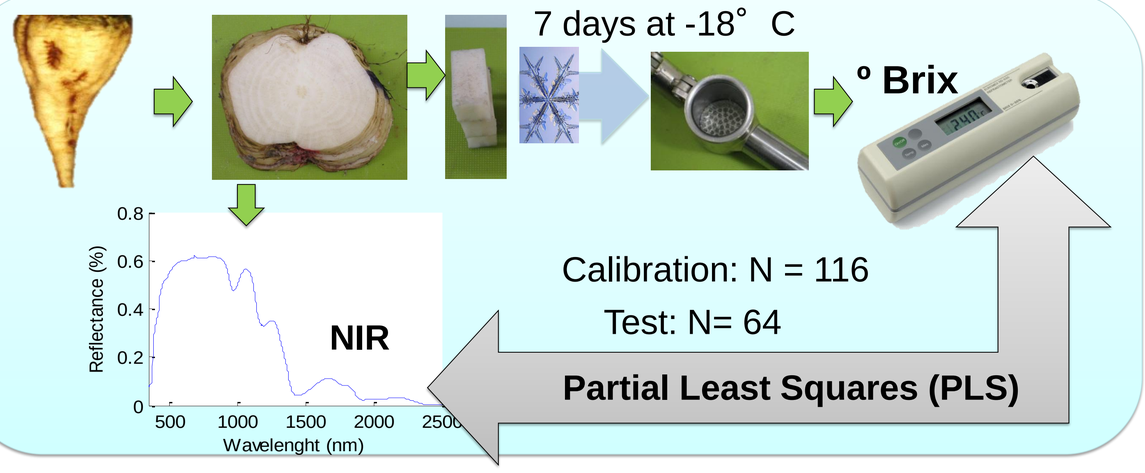
Sugar beet is the second biggest world contributor to sugar production and the only one grown in Europe. One of the main limitations for its competitiveness is the lack of effective tools for assessing sugar content in unprocessed sugar beet roots, especially in breeding programs.

In this context, a dedicated NIR fiber-optic probe is proposed as a suitable approach.

Objective

The objective of this work is to evaluate the use of a self-designed fiber-optic probe for the estimation of Soluble Solid Content (SSC) in intact sugar beets. Two optical configurations were tested and compared.

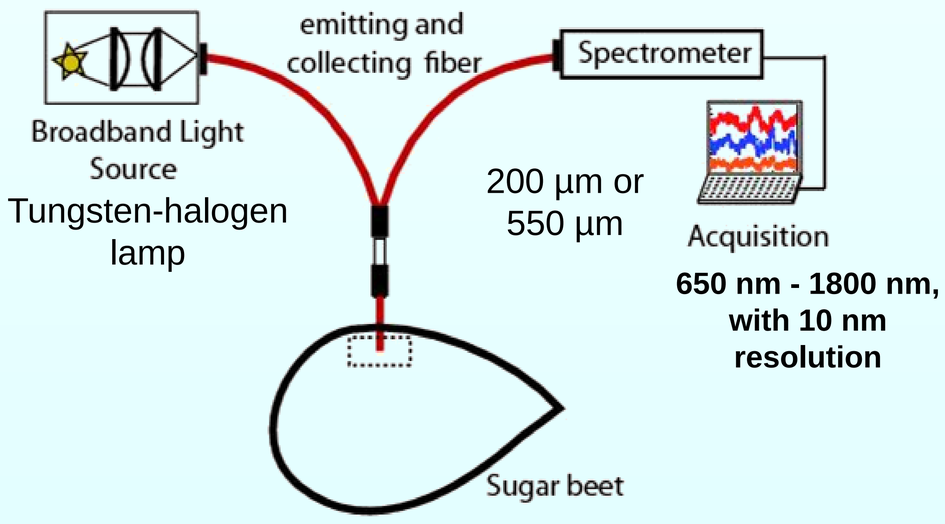
Materials and methods



Optic configurations

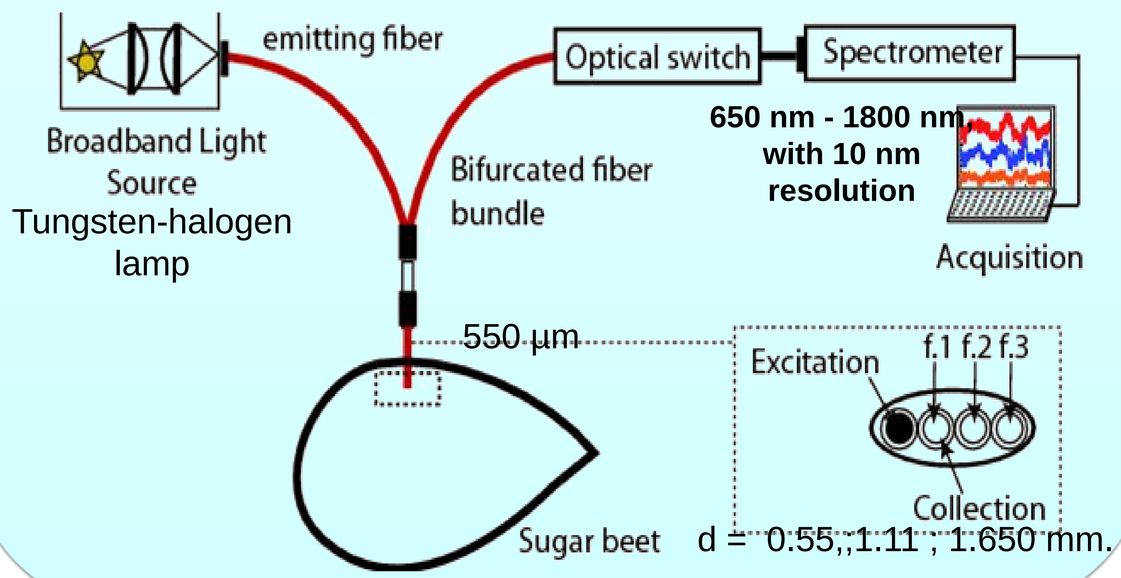
a) Single-fiber probe

Same fiber is used for light emission and collection



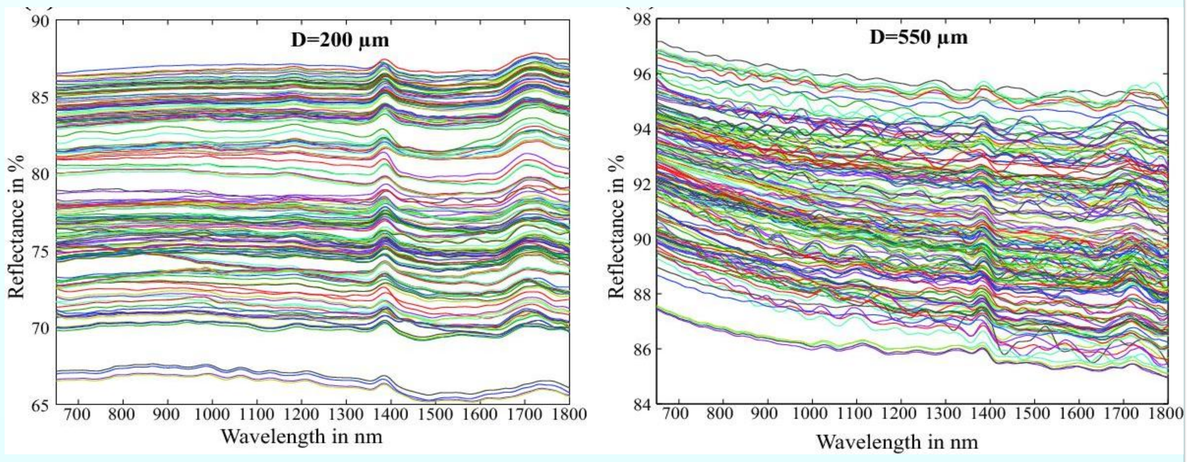
b) Multiple-fiber probes

Separate fibers are used for light emission and collection



Results

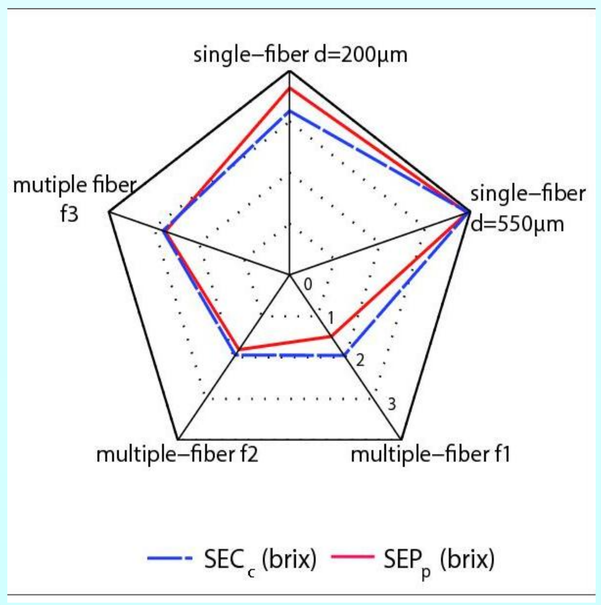
a) Single-fiber probe: fiber diameter test



-**Higher raw reflectance spectra for wider diameters**→ more light injected into the sample (wider size of the spot)

-**Interference pattern more pronounced for the wider diameter** → interference between the waves reflected from end of the fiber and bottom of the sample.

a) + b) Model results (PLS)



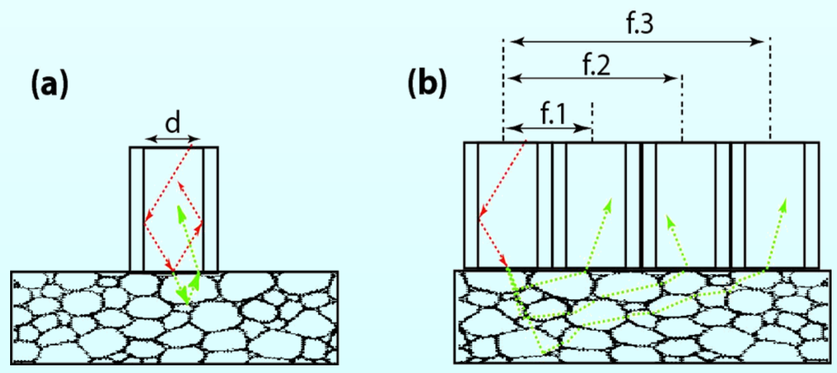
a) Single-fiber probes: Worst model results (R^2=0.645 , SEP =3.66 -3.93 Brix). Smallest diameters provided the lowest SEP

b) Multiple-fiber probes: Good correlation between soluble solids content (SSC) and reflectance spectra for intact sugar beets (R^2=0.90, SEP= 3.30 Brix)

Conclusions

a) Single-fiber probes: Specularly reflected light masks sugars (SSC) absorbance . Model results were not satisfactory

b) Multiple-fiber probes: Best tested configuration. Best results for f1 and f2 fiber distances , which maximize single scattered light over multiply scattered light.



Further work improvements:

- Optimizing the distance between emitting and collecting fiber,
- Reducing the multiple scattering through spectral pretreatments,
- Increasing the number of samples to increase model robustness .

References

Bendoula, R. , Herrero-Langreo, A., Guerrero-Castro, P., Roger, JM. The potential of an invasive but non-destructive fiber-optic probe for soluble solid content prediction, in whole sugar beet. Journal of NIR spectroscopy (In revision).