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Measurement of sugar concentration by multimodal fiber optics sensor

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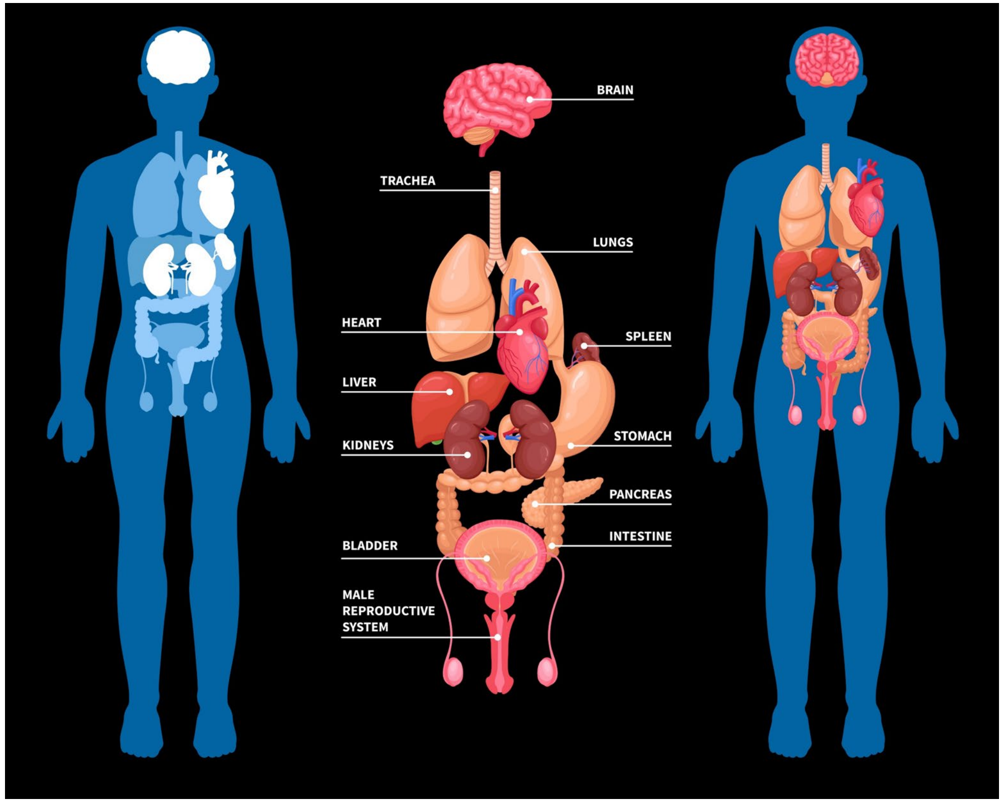
Background



- The sugar: essential for human diet.
- Provides energy for different organs to perform correctly [1,2]
- However, is necessary to distinguish the amounts of sugars present in food.
- An excess of sugar consumption can lead to several health diseases [2].

1. Partearroyo, T.; Sánchez Campayo, E.; Varela Moreiras, G. *Nutrición Hospitalaria* **2013**, *28*, 40-47,
2. Cabezas Zabala, C.C.; Hernández Torres, B.C.; Vargas Zárate, M. *Revista de la Facultad de Medicina* **2016**, *64*, 319-329,

Background

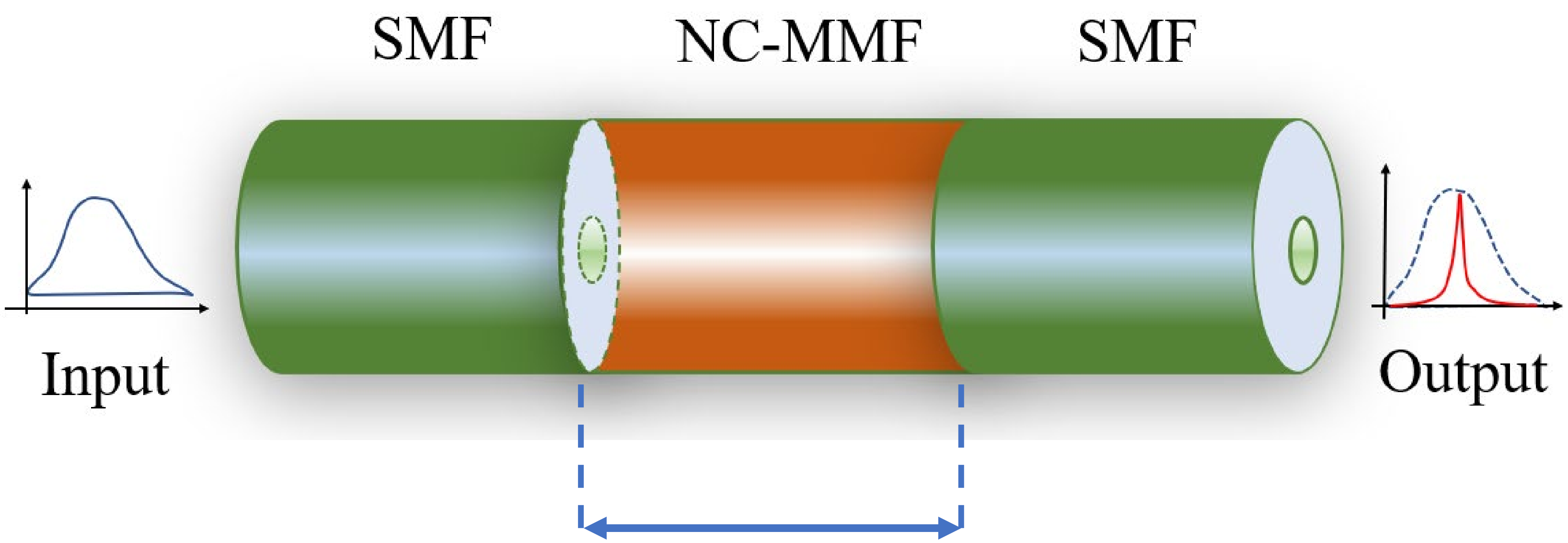
- Several methods are reported to measuring sugar concentrations
- Some of them often require complex manufacturing process or additional peripherical instrumentation.

Aim

- Measuring sugar concentration in aqueous solutions using a fiber optics sensor based on multimodal interference (MMI) by SMS configuration.

Materials and Methods

SMS sensor device:



The NC-MMF fiber must have a specific length to reconstruct the input field [3]:

$$L = p\left(\frac{3L_{\pi}}{4}\right) \quad ; \quad p = 0, 1,2, 3, \ldots$$

$$L_{\pi} = \frac{4n_{MMF}{D^2}_{MMF}}{\lambda_0}$$

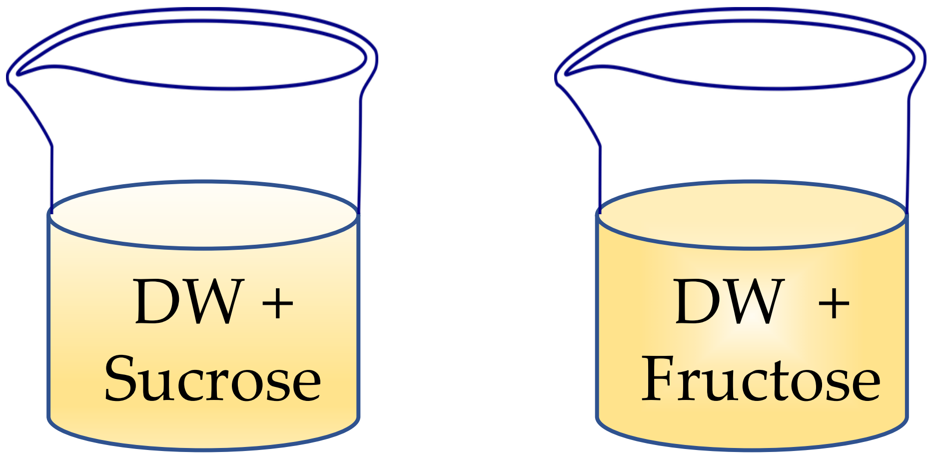
3. Soldano, L.B.; Pennings, E.C.M. *Journal of Lightwave Technology* **1995**, *13*, 615-627

Materials and Methods

Sample preparation:

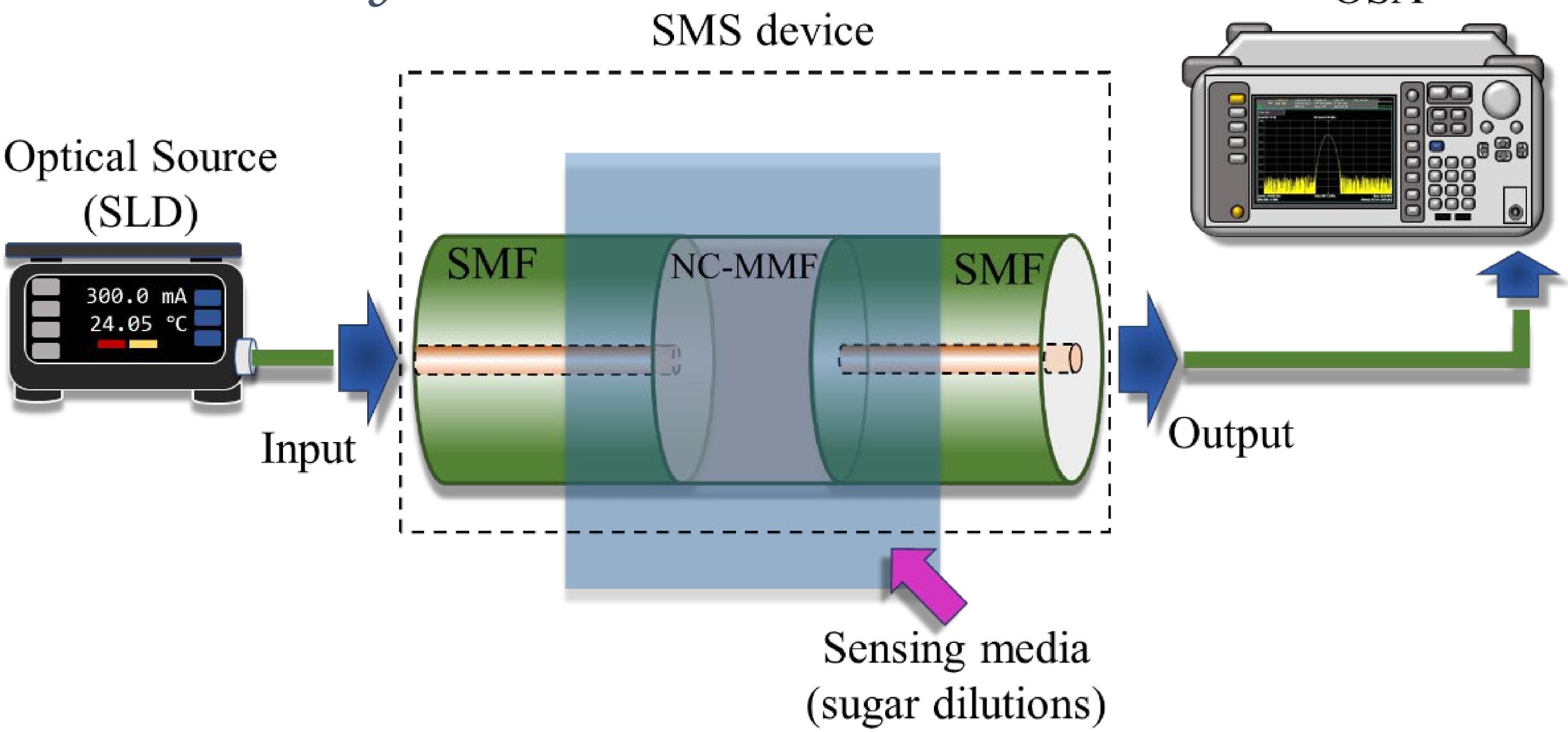
- Water-sugar mixtures were prepared using deionized water (®Sigma Aldrich, 99% pure) and commercial brands of sucrose and fructose.

- The mixtures range: 0.5%v/v to 18.5%v/v with increments of 1.5%.



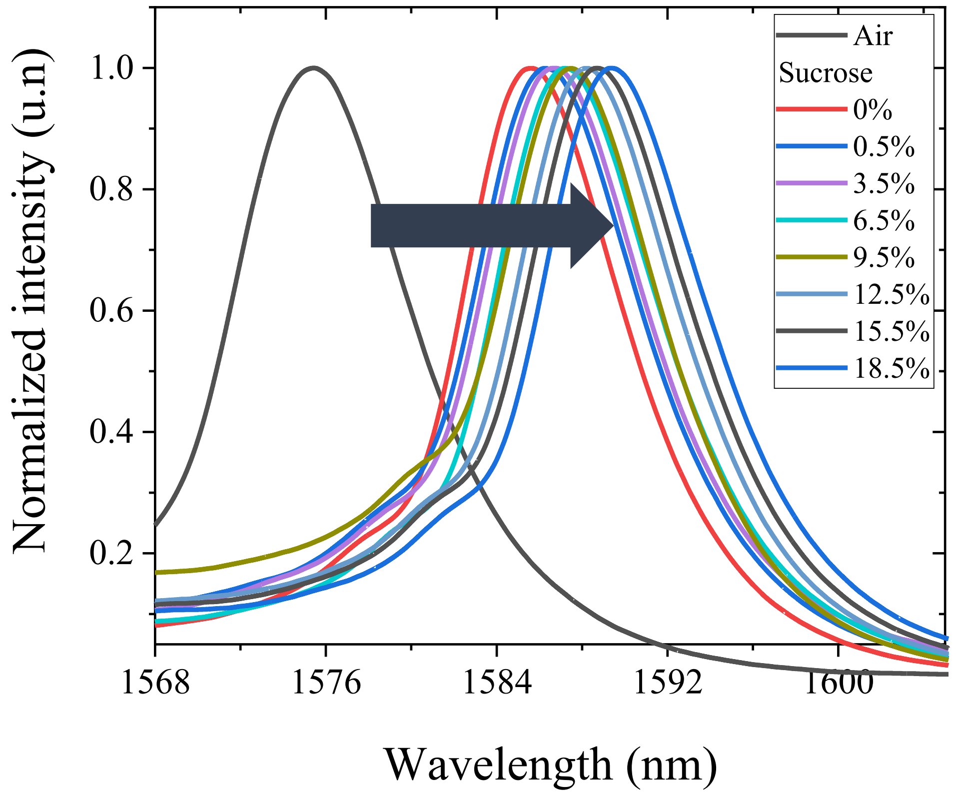
Materials and Methods

Experimental array:

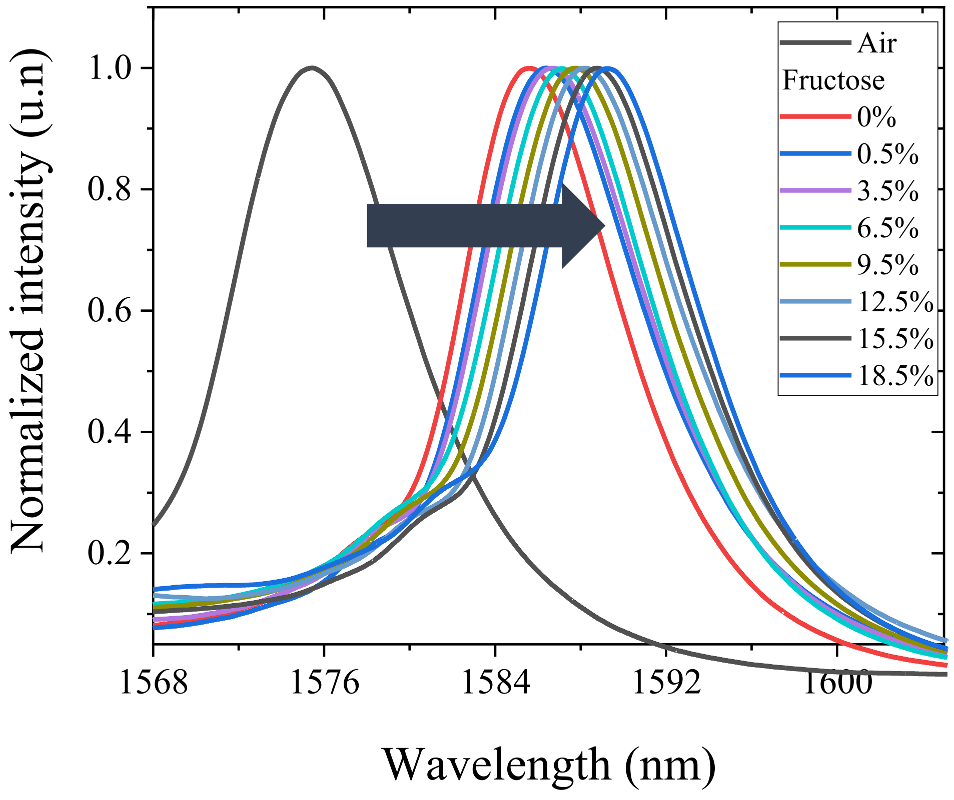


Results

- The response of the fabricated sensor with sucrose and fructose dilutions.



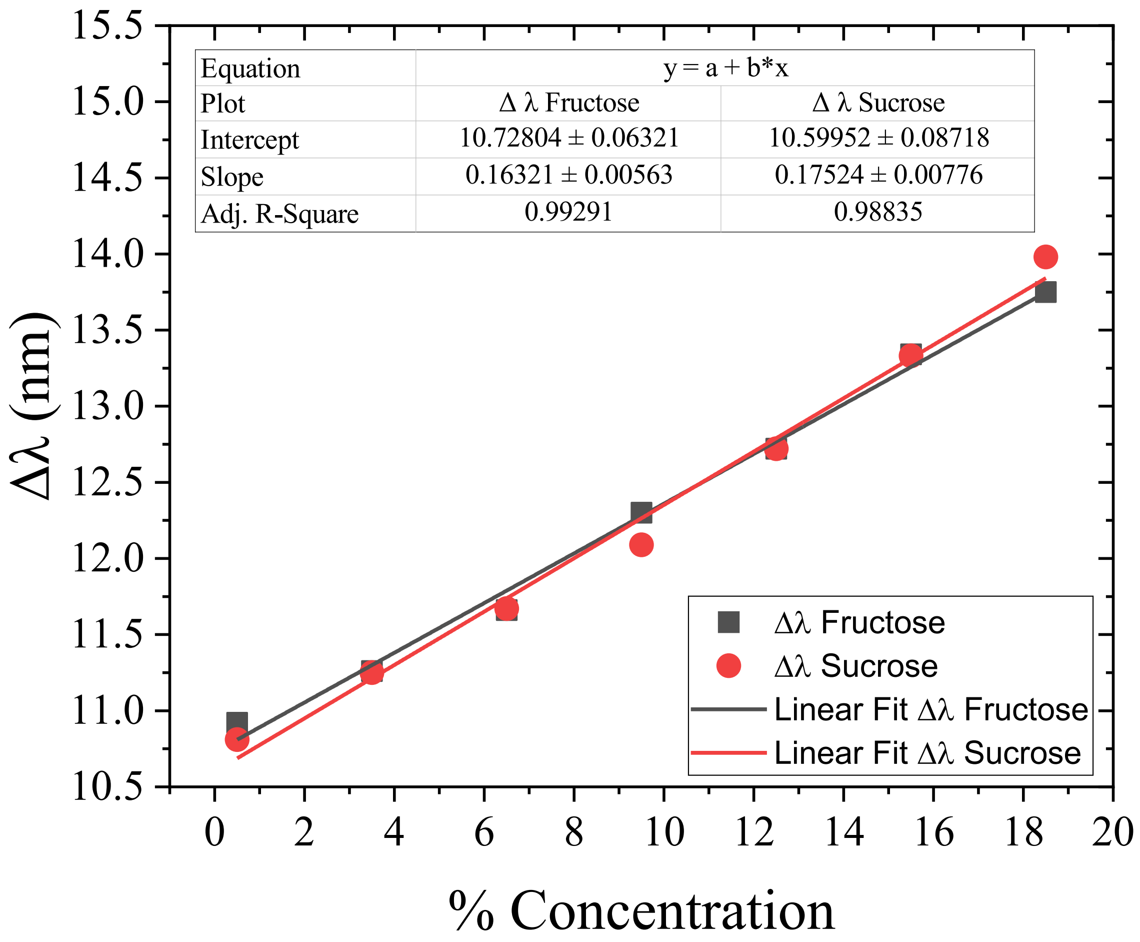
(a) Sucrose spectral displacement



(b) Fructose spectral displacement.

Results

- The spectral shift wavelength peak $\Delta\lambda$ as function of sugar concentration.



The sensor exhibits a linear response with a sensitivity:

- 0.17524nm/% for sucrose
- 0.16321nm/% for fructose

Conclusions

- SMS sensor allows detecting different concentrations of sucrose and fructose in aqueous solutions.
- The sensor exhibits a linear response to sugar concentration (~ 0.17524 nm/% for sucrose and 0.16321nm/% for fructose).
- The sensor has a simple construction, low cost, and linear response. Do not require additional processes.
- Capable of performing real-time measurements and potential use as a quality control tool.

Thanks for your attention