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Data Article

CO₂ and O₂ solubility and diffusivity data in food products stored in data warehouse structured by ontology

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Abstract

This data article contains values of oxygen and carbon dioxide solubility and diffusivity measured in various model and real food products. These data are stored in a public repository structured by ontology. These data can be retrieved through the @Web tool, a user-friendly interface to capitalise and query data. The @Web tool is accessible online at http://pfl.grignon.inra.fr/atWeb/.

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Specifications Table

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2352-3409/© 2016 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
How data was acquired
Chemical titration (for CO₂ quantification) and luminescence-based detection (for O₂ detection) implemented in dedicated experimental set-ups

Data format
Analyzed, ready to use

Experimental factors
Samples considered are model and real food products without any pre-treatment except addition of sodium azide to avoid microbial growth

Experimental features
Solubility is measured by quantifying the concentration of dissolved gas in a sample in equilibrium with a fixed and controlled partial pressure. Diffusivity is identified from an experimental diffusion kinetic curve by using a mathematical model and appropriate numerical treatment (algorithm of optimization).

Data source location
University of Montpellier, FR-34060, France

Data accessibility
Data is within this article.

Value of the data

- A unique set of CO₂ solubility and diffusivity data indispensable in food engineering to model CO₂ gas transfer in food.
- A unique set of O₂ diffusivity values within synthetic oils as a function of temperature.
- O₂ diffusivity data could be used to predict oxidation of O₂-sensitive compounds in foods.
- These data could serve as benchmark for other researchers coping with research on gas transfer in food for numerous simulation.

1. Data

Data shared with this article are more than 100 data of solubility and diffusivity of gases (O₂ and CO₂) in food samples. These data are stored in a data warehouse called @Web in which the data management is guided by ontology.

All data are available for uploading at the URL specified below and recalled in the table hereafter with the details about the nature and amount of data available at each URL.

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2. Experimental design, materials and methods

O$_2$. Oxygen optical sensors (Presens GmbH, Regensburg, Germany) were used to monitor O$_2$ partial pressure. This measurement is based on dynamic luminescence quenching. Due to an excitation flash emitted through an optical fibre, the luminophore contained in the sensor goes into an excited state and thus emits fluorescence backscatter signal, which is detected by the optical fibre. If the luminophore is in contact with an oxygen molecule, the backscatter signal is changed due to a dynamic quenching of luminescence. The change in the backscatter signal permits to detect the O$_2$ partial pressure in the medium. Two different set-ups exist (1) an invasive O$_2$-sensitive optical sensor made of a syringe probe (micro-sensors, Presens GmbH, Regensburg, Germany) connected to the optical fibre and oxygen metre (Oxy-4 micro, Presens) and (2) a non-invasive oxygen sensor made of a dot of 5 mm of diameter that can be stuck on the wall of a transparent container and measurement is then made through the transparent container.

Oxygen sorption kinetics were measured at fixed temperature value when imposing a controlled partial pressure of O$_2$ in the surrounding of the sample. The mono-directional O$_2$ ingress into the sample was measured locally at the bottom or in the middle of the thin layer of food material previously free of O$_2$ using one of the aforementioned sensors. More details on the experimental set-up could be found in [1–3].

CO$_2$. The solubility of CO$_2$ was measured at equilibrium by quantification of the gas dissolved in the sample using chemical titration [4,5]. This measurement was done in a set-up where the sample is in a controlled chamber (controlled temperature, relative humidity, CO$_2$ gas composition).

The diffusion of CO$_2$ was characterised by (1) imposing a gradient of CO$_2$ to a piece of material of simple geometry (cylinder or plane sheet), (2) measuring the CO$_2$ sorption kinetic in the sample and (3) identifying diffusivity values by adjusting a dedicated mathematical model to the experimental kinetic. Two types of kinetic could be obtained: (1) CO$_2$ space-dependent profile in the cylindrical sample after its slicing and CO$_2$ quantification in each slice or (2) CO$_2$ time-dependent profile after CO$_2$ quantification in each thin slice (one slice corresponding at one time of kinetic) [4,6].

Numerical treatment. For both O$_2$ and CO$_2$, diffusivities are identified by fitting a dedicated mathematical model to the experimental kinetic curve (space-dependent profile or time-dependent profile). This identification step is performed using a routine (“lsqnonlin”) of Matlab® software.

Acknowledgements

Part of the data presented here were acquired in the framework of the Map’Opt project (ANR-10-ALIA-002 2011 to 2015) funded by the French National Research Agency, whose title is “Equilibrium gas composition in modified atmosphere packaging and food quality”.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2016.04.044.

References