The distribution of sodium within cooked food and sodium interactions with the matrix depends on both food matrices and salting practices

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The quantification of nucleus density by magnetic resonance imaging (MRI) gives us access to salt distribution in cooked food matrices. In this work we investigated the final distribution of Na^+ in a carrot as food matrix either boiled in salted water or salted after cooking. One of the working hypothesis is that the more the salt is heterogeneously distributed, the stronger the salt perception will be.

Materials and methods

➢ Samples

- Carrot cooked for 20 minutes into salted (117 mmol/L) boiling water
- Carrot cooked for 20 minutes into boiling water then 0.5% (m/m) of salt added.
- 3 references tubes of porcine gelatin and sea salt at three concentrations of Na^+ : 85 mmol/L, 117 mmol/L, 343 mmol/L.

Fig 1: Picture of the equipment (Bruker Ascend 400WB with a Ø 3mm 1H/23Na volume radiofrequency antenna) and the set-up of a sample in the radiofrequency antenna.

➢ Sodium MRI challenges:

- Sensitivity
- Quantification

➢ Parameters of the MRI acquisition

- Chemical Shift Imaging pulse sequence
  - Duration for quantitative salt distribution : 1 h 30 min
  - Duration for salt penetration follow-up : 35 min
- Spatial resolution 0.5x0.5x8 mm^3

Images corrections: Radio Frequency excitation field heterogeneities, static magnetic field heterogeneities, NMR relaxation.

Results

➢ **The quantitative maps results show that the sodium distribution is more heterogeneous in the carrot salted after cooking than in the carrot salted during cooking**

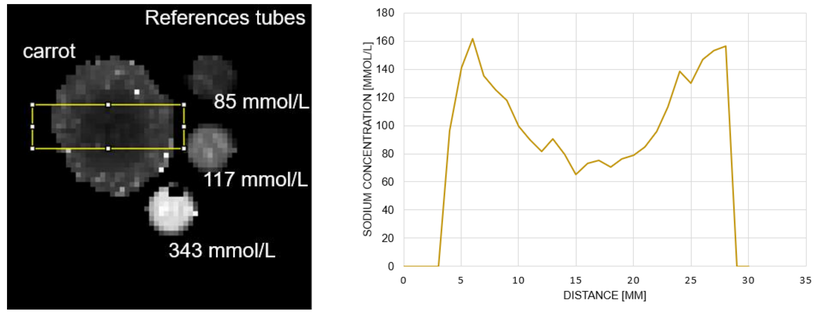

Fig 2. Quantitative 23Na map of a carrot cooked in salted water (left) and its left-right profile of the sodium concentration (right)

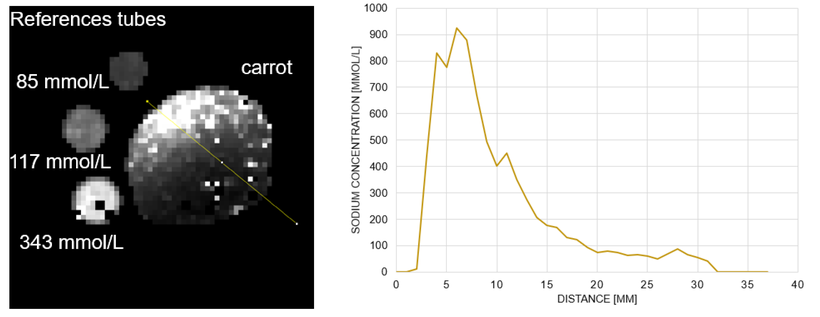

Fig 3. Quantitative 23Na map of a carrot cooked in water and then salted (left) and its left-right profile of the sodium concentration (right)

➢ **The salt diffusion during 5 hours after the 20 minutes of cooking for cooked carrot either salted during cooking or salted after cooking show an homogenization of the sodium**

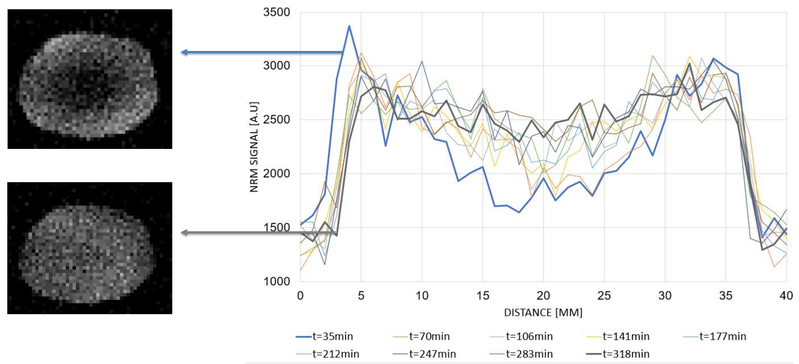

Fig 4. Raw 23Na NMR signal of a carrot cooked in salted water, first acquisition (top-left) and last acquisition (down-left) and the graph of the salt distribution for the nine acquisitions (right). The experiment lasted approximatively 5 hours.

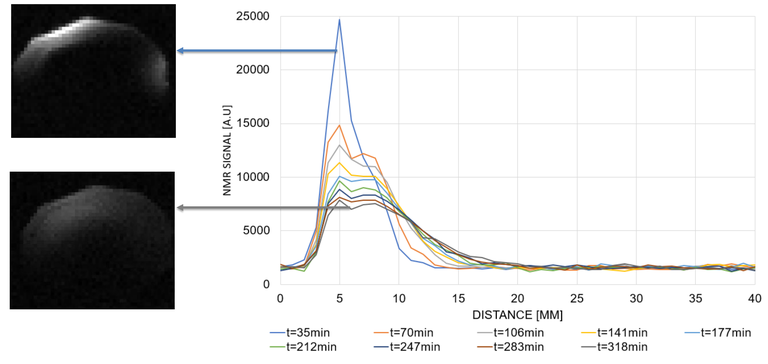

Fig 5. Raw 23Na NMR signal of a carrot cooked in water and then salted, first acquisition (top-left) and last acquisition (down-left) and the graph of the salt distribution for the nine acquisitions (right). The experiment lasted approximatively 5 hours.

Sodium distribution depends on the moment of salt added for cooked carrot. This effect of salting moment has to be studied further and on other matrices. Afterward, relationships with sensory evaluation data (esp. salty taste) will be established with salt heterogeneities and the dynamics of salt release in the mouth for the two matrices will be followed. This project aims to find levers to minimize the salt used during the preparation of meals at home.

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