

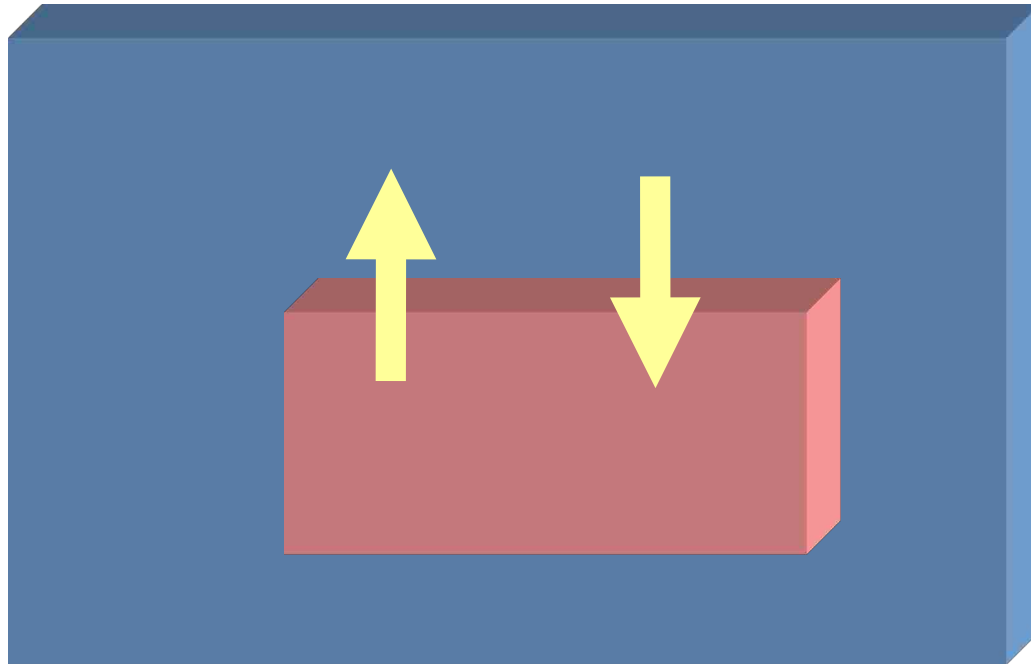
Taste changes in carrots during cooking



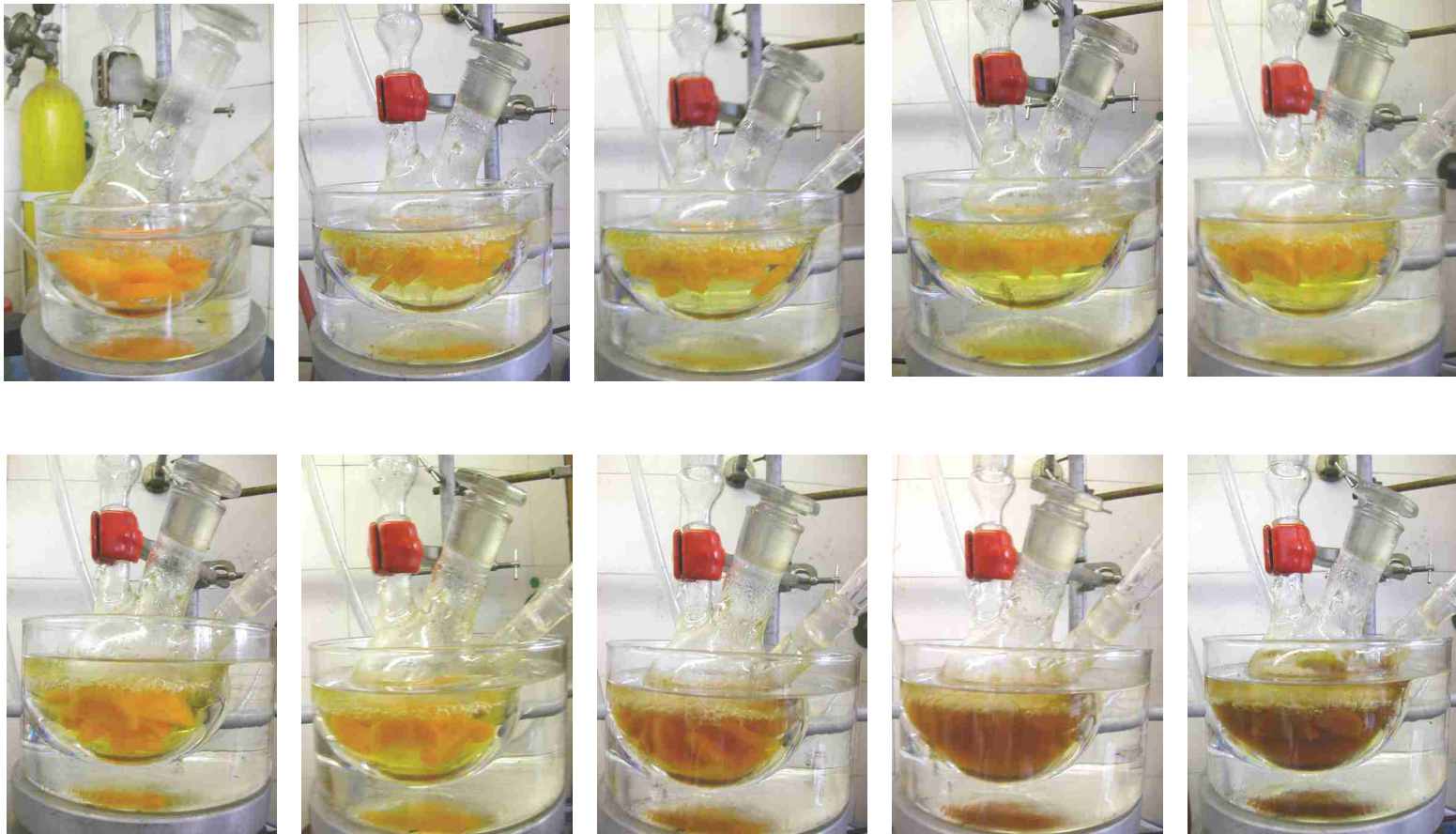
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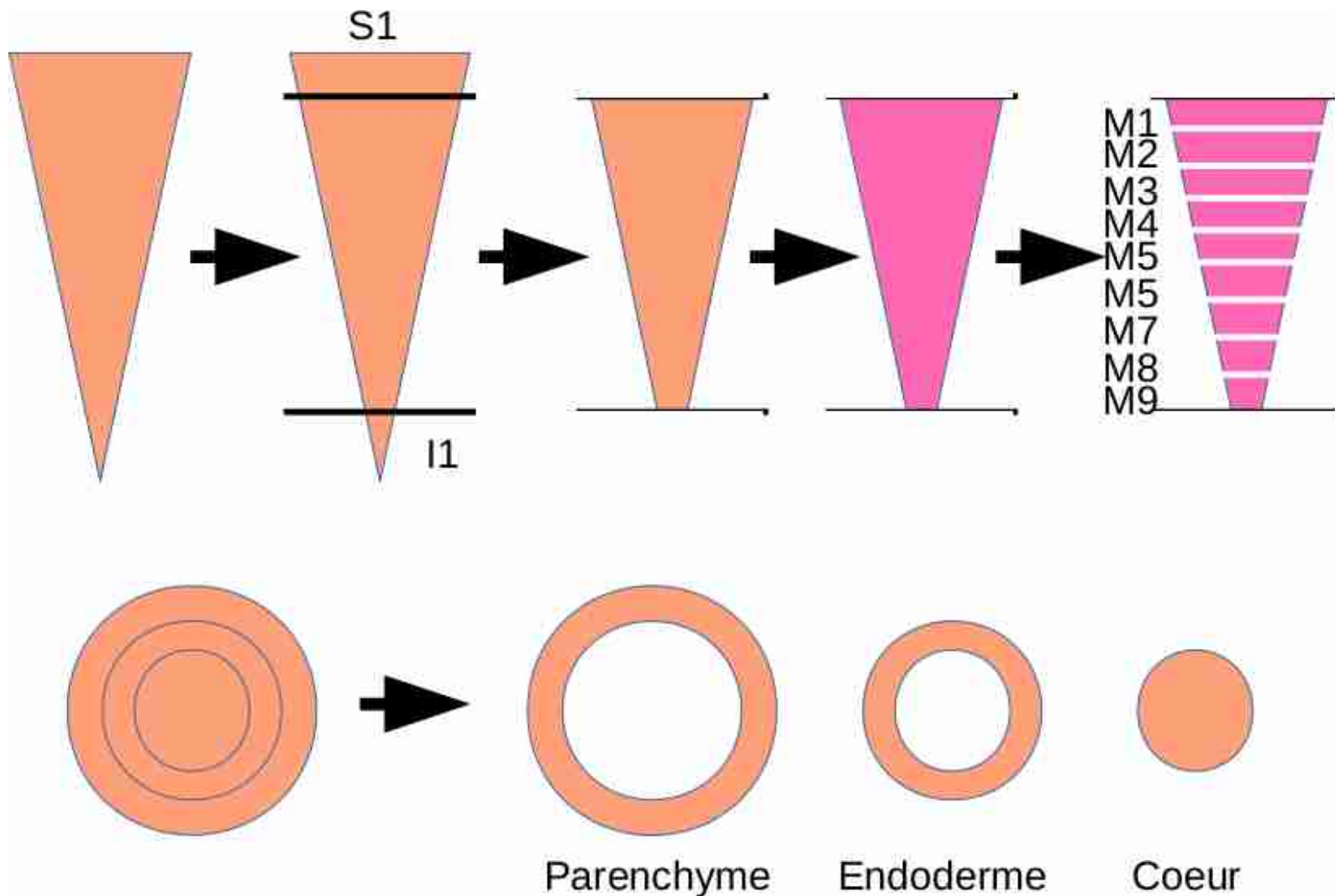
The general question of “exchanges S@W” HOW ?



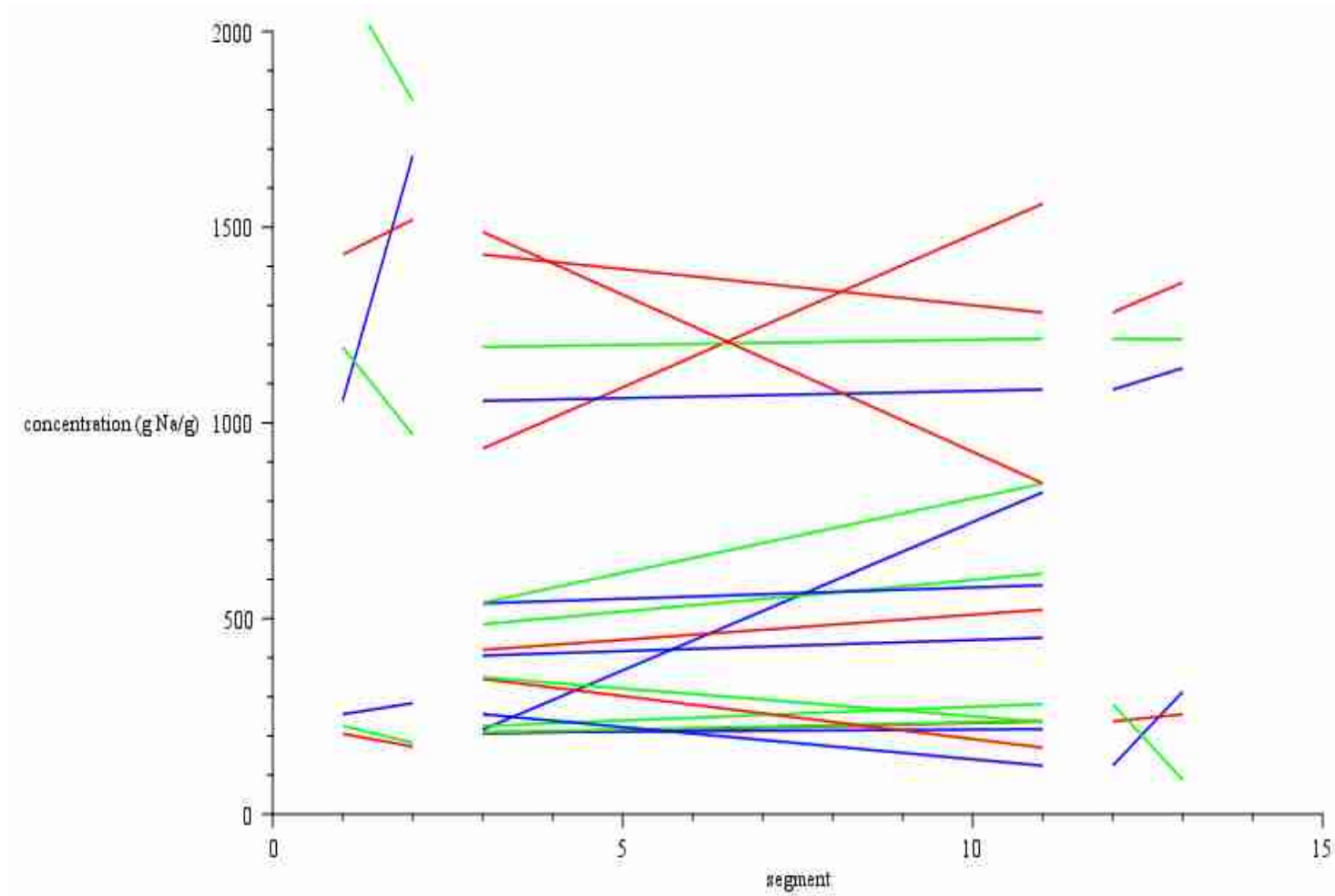
“Carrot stocks”



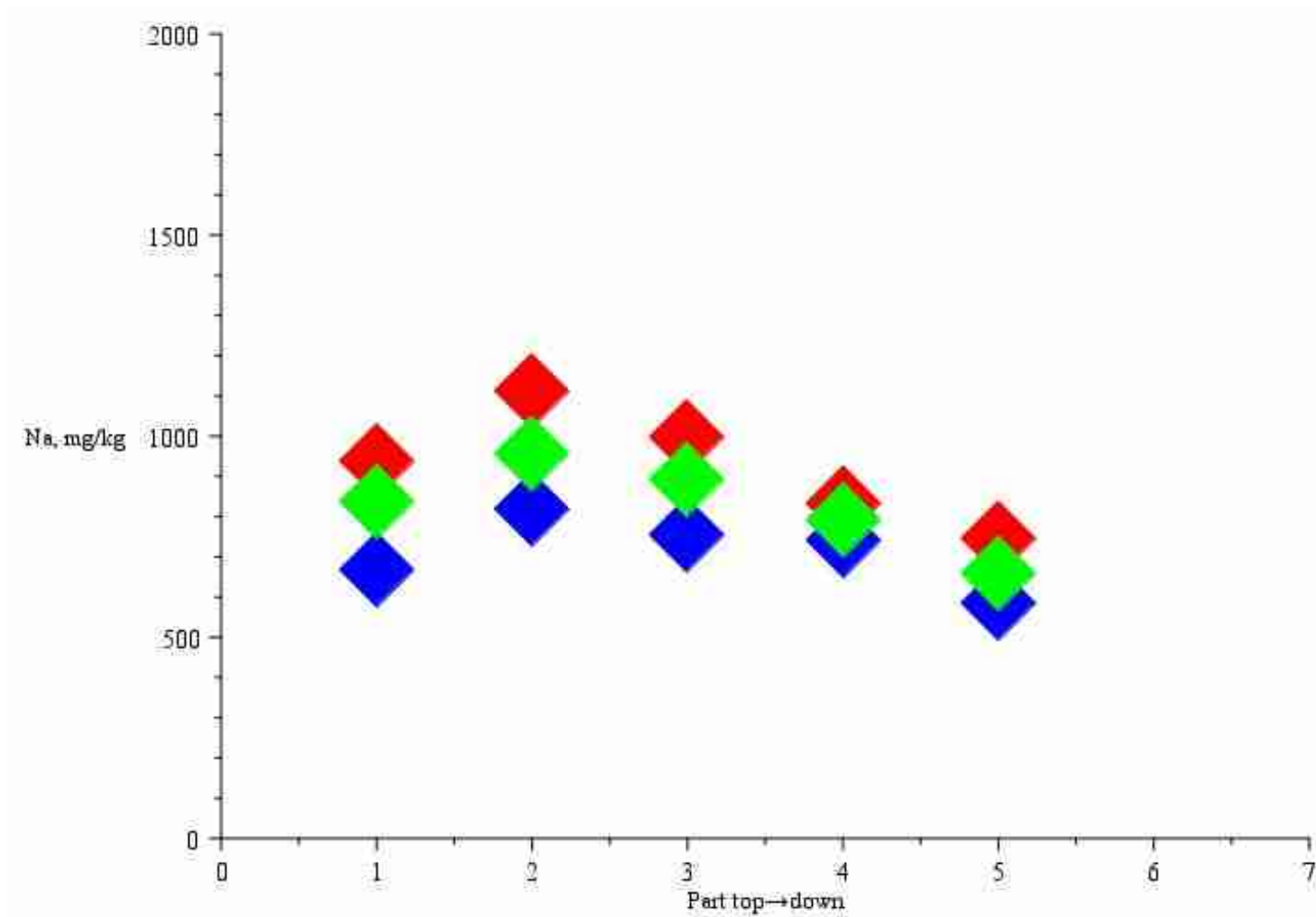
Preparation of samples



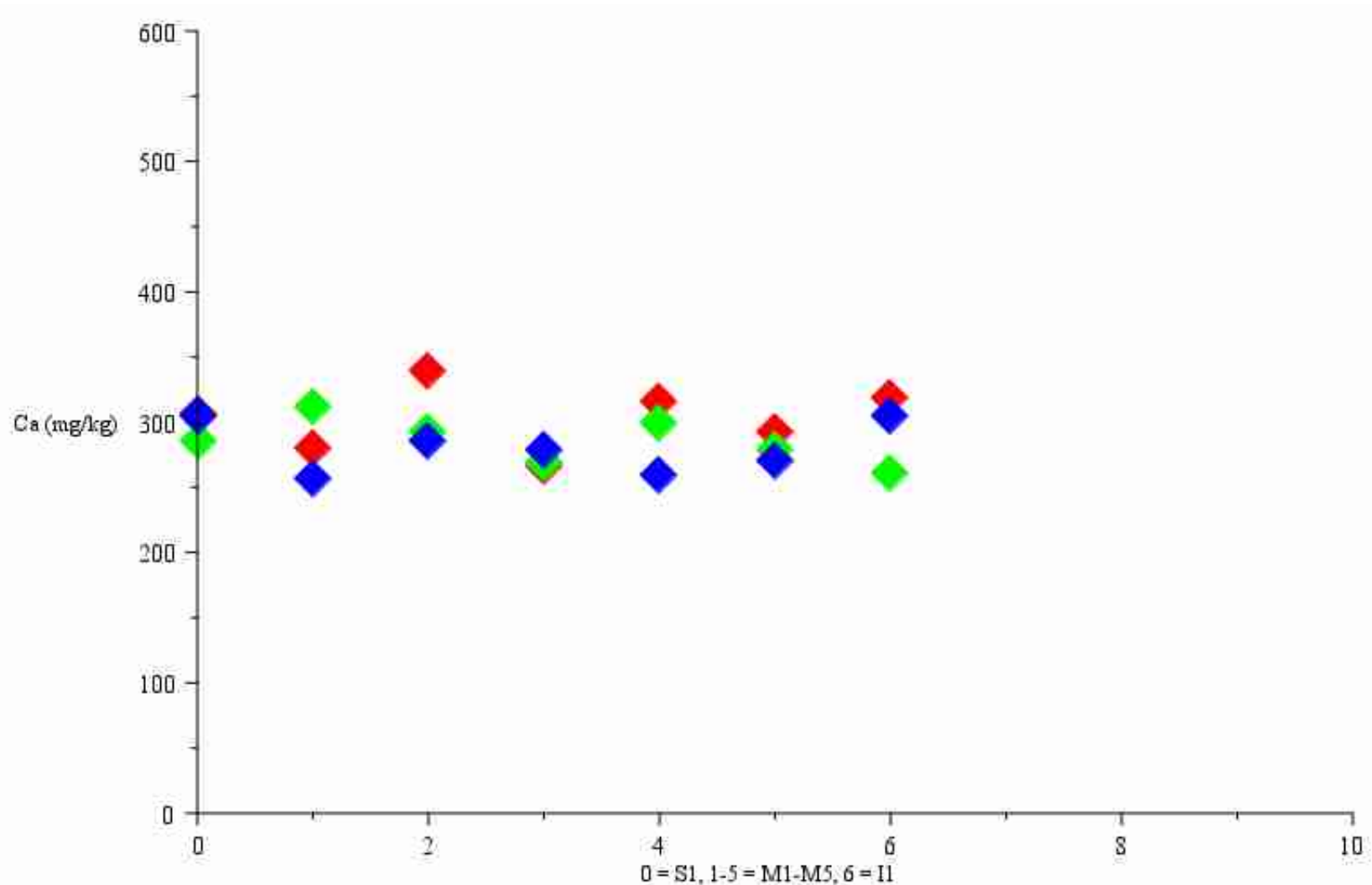
Na⁺ concentration in the top and bottom ends



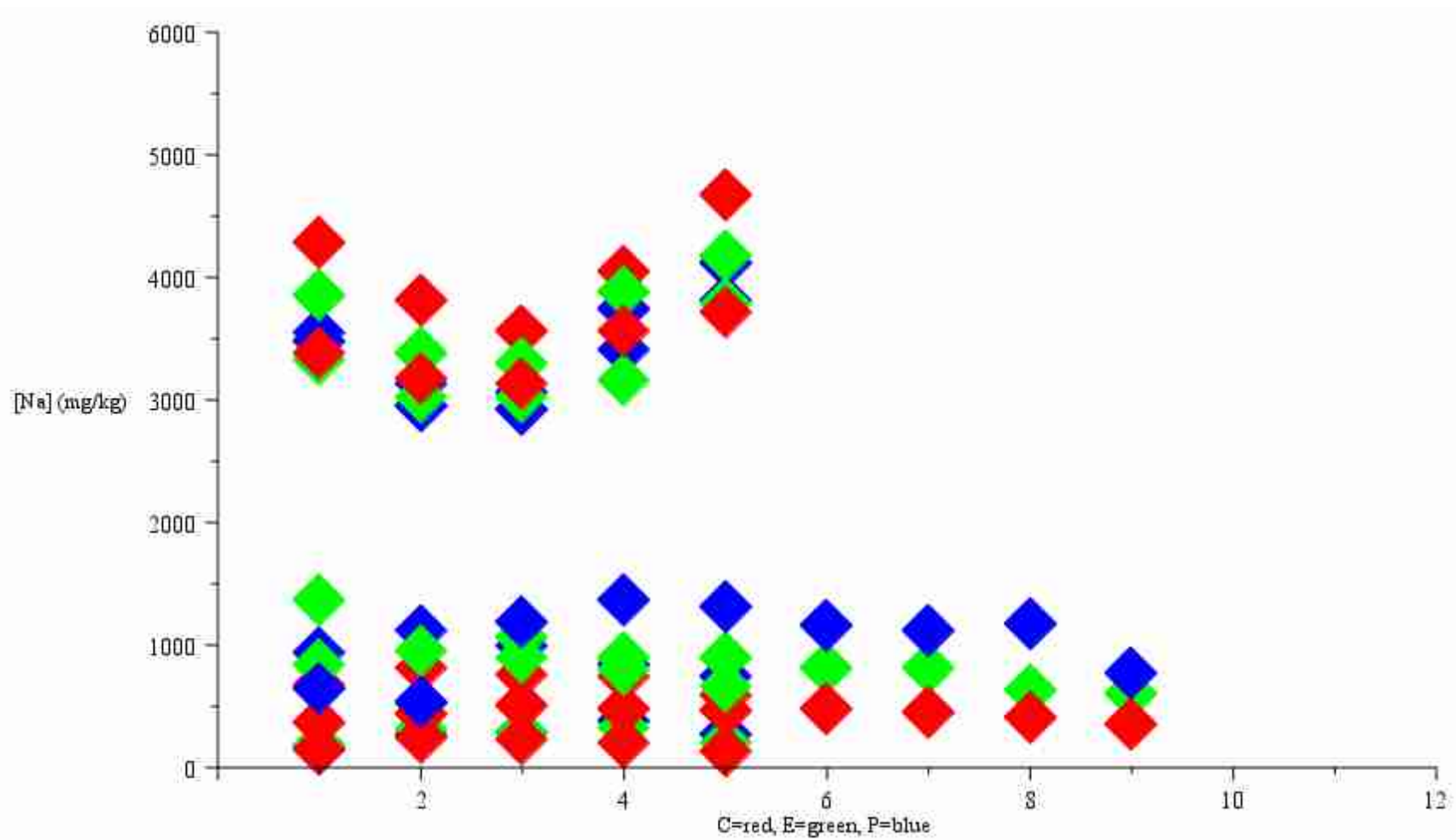
[Na⁺] when cooked in distilled water



Ca²⁺ concentration when cooked in distilled water



Na⁺ concentration when cooked in saltier water



After calculation from the data (2)

Why do some roots contain more Na^+ than others ?

As other studies (different scientific programs, also studying carrots) led to conjecture that the size of the roots could be correlated with this distribution, we checked for correlations between the average Na^+ concentration in raw tissue and the mass of the root; **the assumption was refuted.**

After calculation from the data (3)

A model for the density of xylem channel as a linear increasing function of the elevation in the root was tested, but this relationship was not found, i.e., the simplistic model did not hold, which confirmed that **the apoplastic and symplastic pathways have to be taken into account in order to describe Na⁺ distribution in roots**

After calculation from the data (4)

For Exp- experiments of thermal processing in initially pure water, the Na^+ distribution has **the same overall shape as if Fickian diffusion occurred from initially loaded channels** (xylem, phloem), but the complex structure of plant tissue prevents making such a simplistic assumption; “molecular diffusion” can only take place locally, in some compartments, and many interactions of ions can occur with the various charged compounds inside the plant structure, such as proteins, pectins, etc.

After calculation from the data (5)

In order to find information on the mechanisms for Na^+ transport, **the concentration of calcium (Ca^{2+})** was also determined in the same plant tissues, with very different results. Here, the **curved profile is not observed** (as measured from a mean curvature radius), showing that **the mechanisms for Na^+ and Ca^{2+} transport inside the plant tissue are different.**

After calculation from the data (6)

Also, the variation of Na^+ content in the processing liquid before and after treatment was compared to an estimation of losses from the plant tissue, these losses being calculated from the difference between the concentration of a slice and the concentration of the nearest raw slice (for the middle slice, the difference was either calculated with the S1 slice, or with an average value for S1 and I1). With this calculation method, it was observed that no lateral transfer is generally needed to explain the first experiment (Exp-1); however no conclusion can be made with experiment Exp-2, because the recovery of the liquid was not enough; for experiment Exp-3, the liquid got more Na^+ than was went out from the plant tissue, so that **lateral transfer cannot be excluded**.

After calculation from the data (7)

For the thermal processing in an aqueous solution of NaCl (Exp+ experiments), the upper and lower ends take in some Na⁺, with much differences between the various (C, E, P) parts of the root. In order to see whether only the end parts interacted with the solution, or alternatively if Na⁺ was also exchanged laterally, the lost quantity of Na⁺ (determined from the raw adjacent part, in the assumption that the Na⁺ distribution would be regular) was compared with the Na⁺ concentration in the solution after processing; **it appeared that the decrease of Na⁺ from the solution was only about 10 % less of what was absorbed from the plant tissue.**

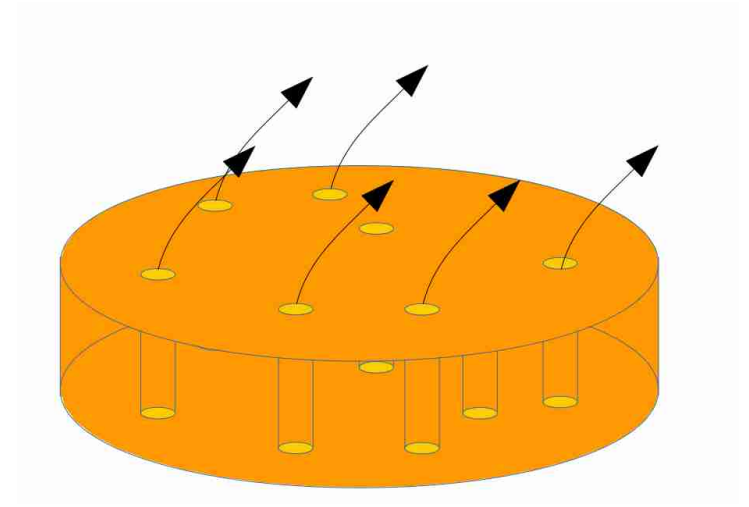
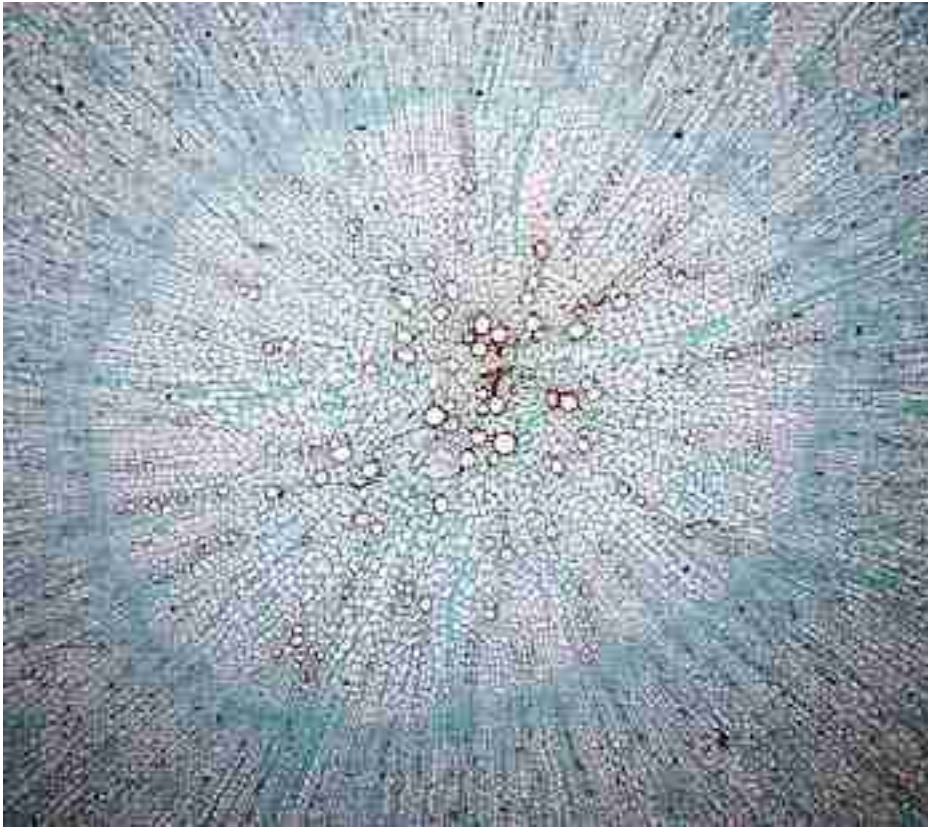
After calculation from the data (8)

On the pictures, it cannot be guessed which part of the carrot contains more Na^+ , so that we calculated the difference of concentrations between the P and C part, and the result is clear: for Exp- experiments, the difference is negative, whereas it is positive for Exp+ experiments. Also, for Exp- experiments, the difference is negative for P and E parts, whereas it is positive for Exp+ experiments. And the E part is in between, both for Exp- and Exp+ experiments. **This shows that, contrary to an assumption that we made, Na^+ is transferred laterally.**

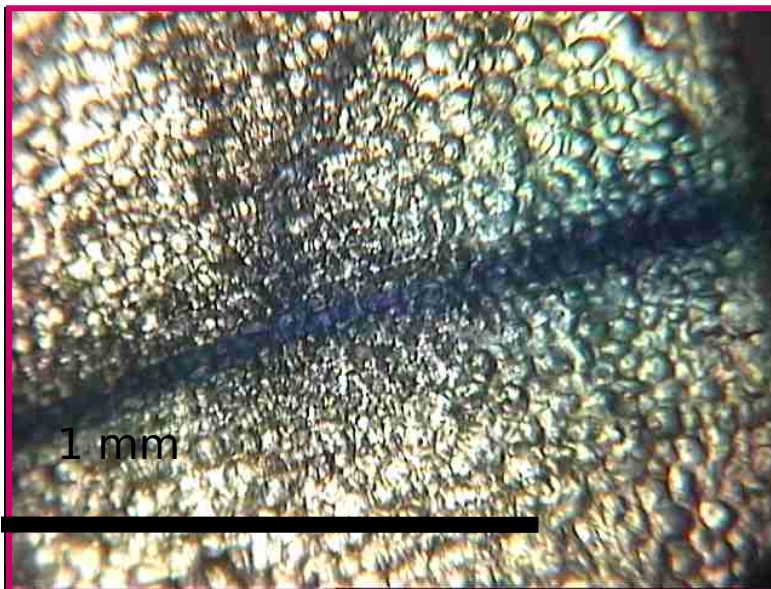
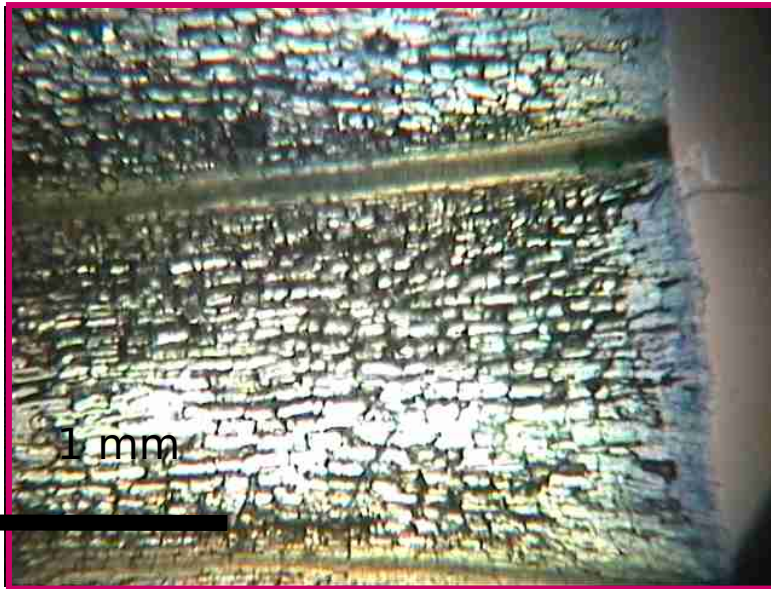
What calculation says

- 1. important differences depending on carrot roots**
- 2. no correlation with the size of the roots**
- 3. strange that there is no difference between the top and the bottom**
- 4. very likely lateral transfer**

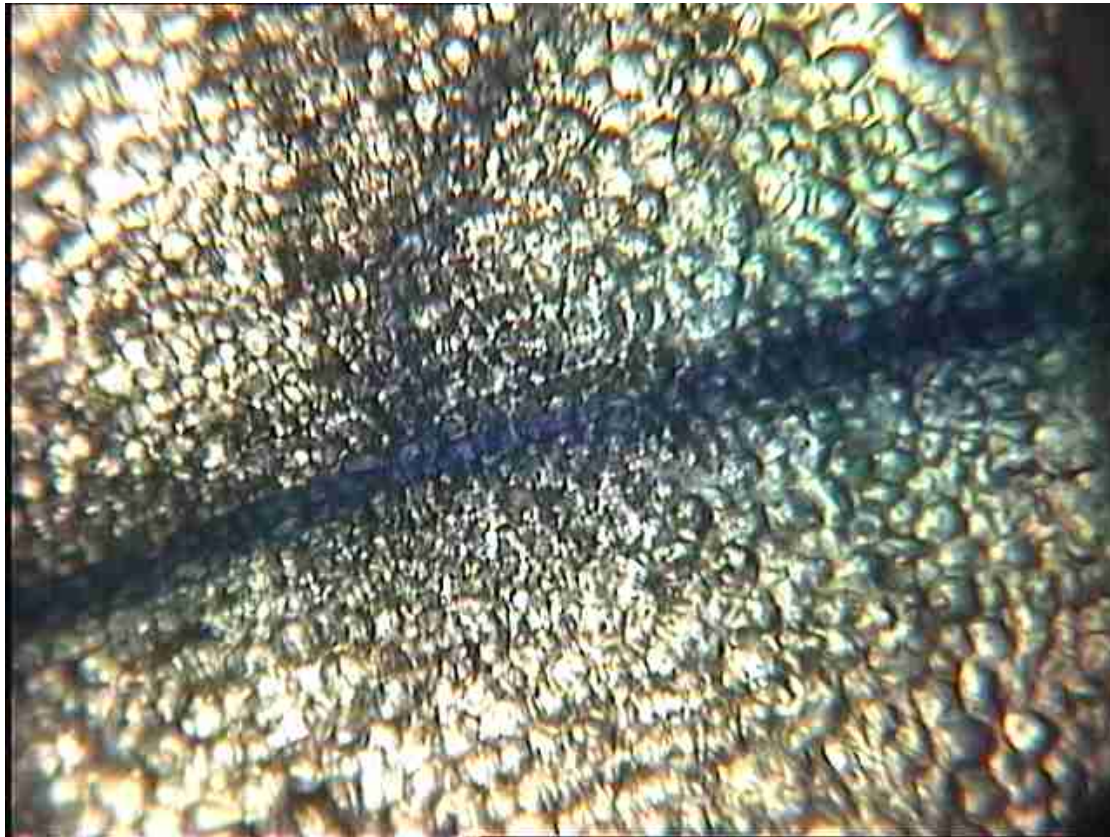
Our first "wrong" theory (for sugars)



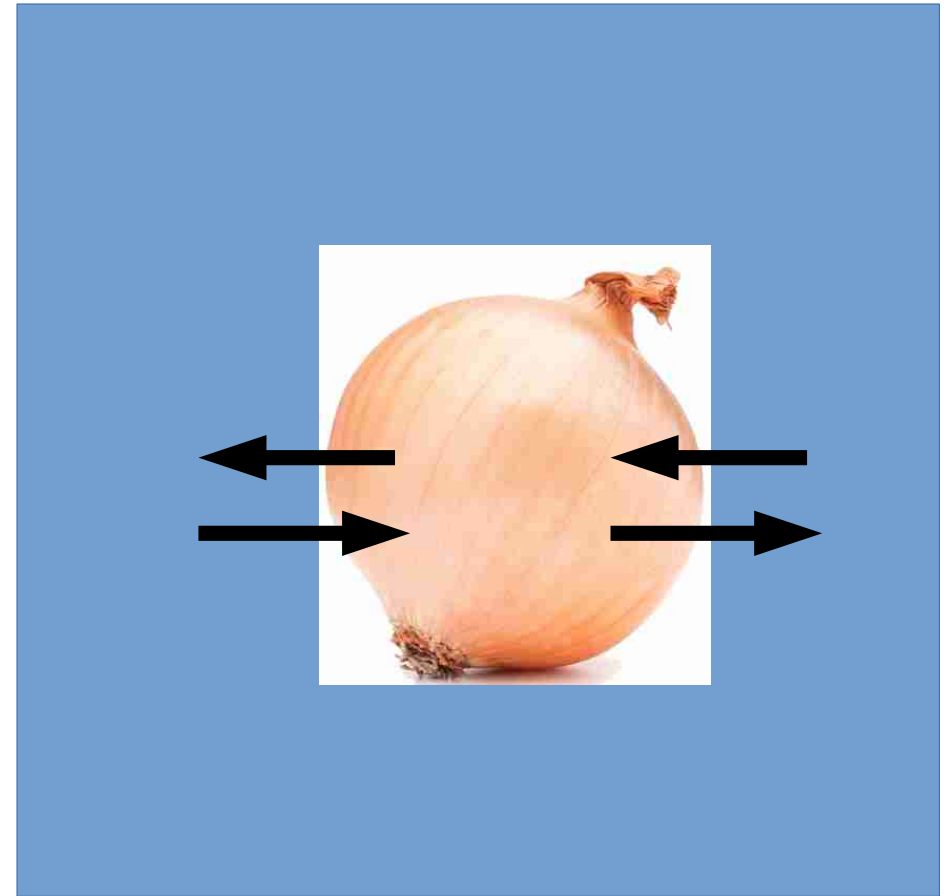
Diffusion ?



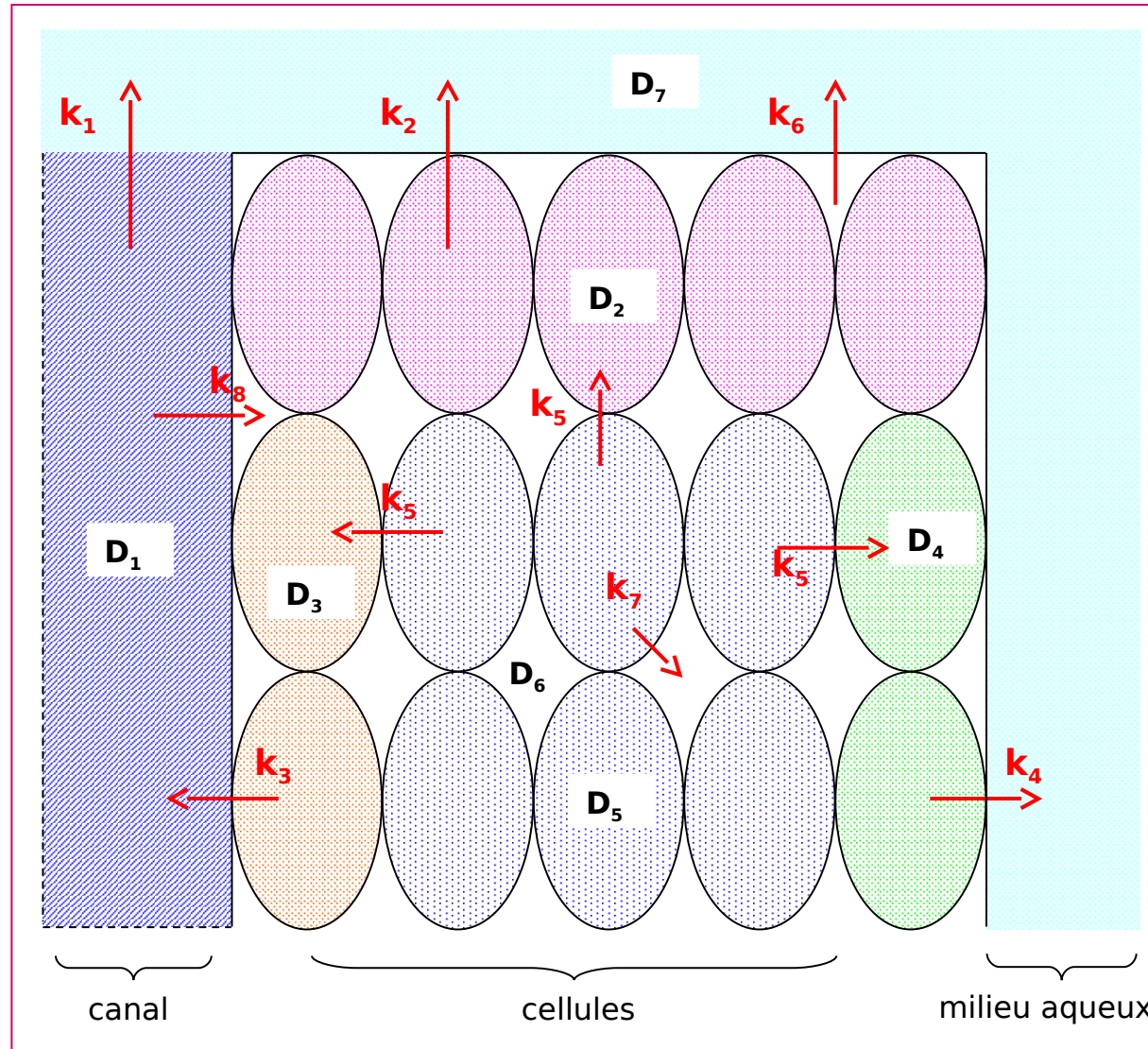
But the theory was wrong (it was known)



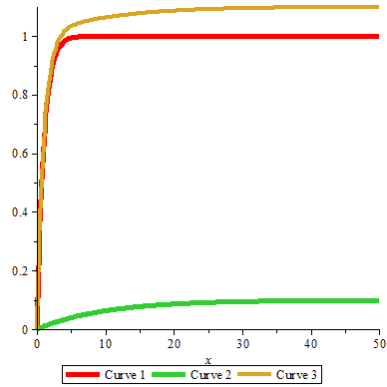
Onions : improved model



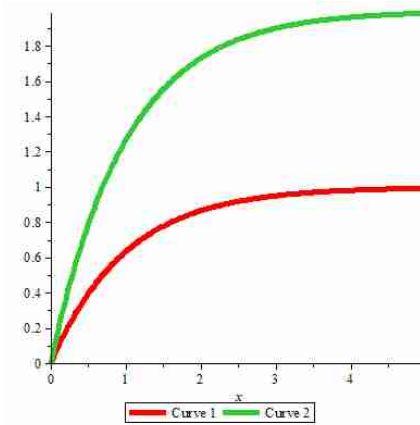
First, how much ?



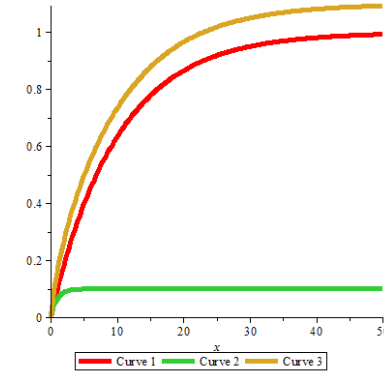
More metabolites in cells,
fast release from cells



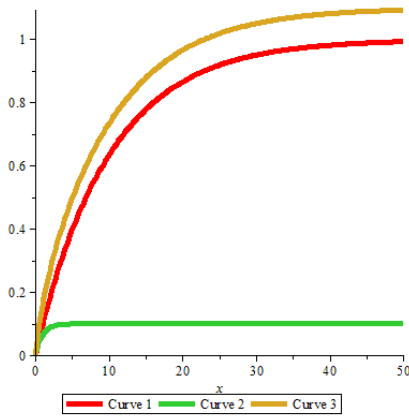
Same quantity, same speed
More metabolites in channels,
Slow release from channels



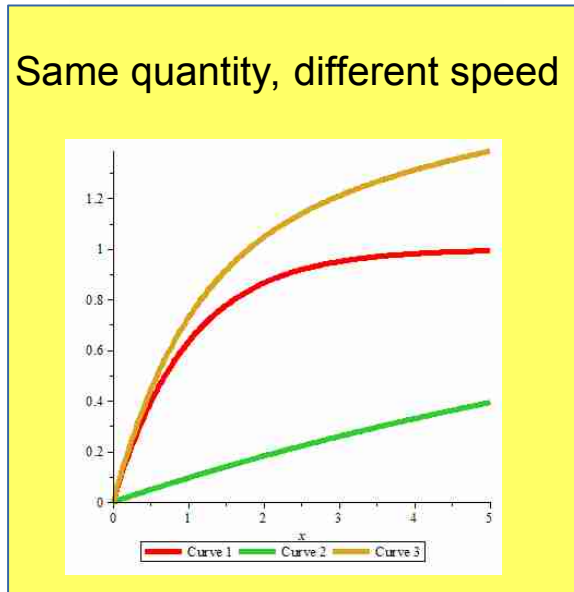
More metabolites in channels,
Slow release from channels



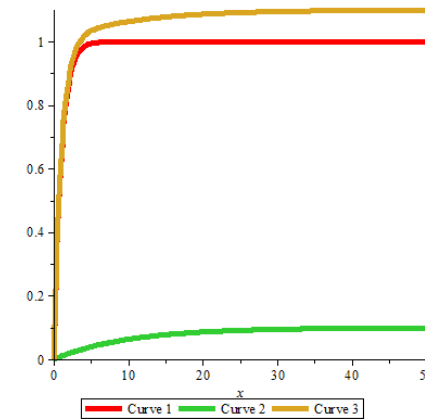
More metabolites in cells,
slow release from cells



Same quantity, different speed



More metabolites in channels,
fast release from channels



... but validations are needed !

After calculation from the data (1)

Large differences (variation coefficients reaching 1.1) in Na^+ content were observed between different roots.

Celebrate calculation!

