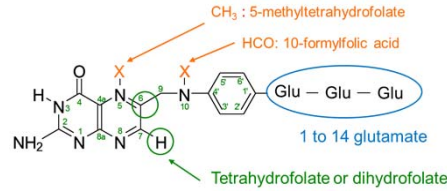
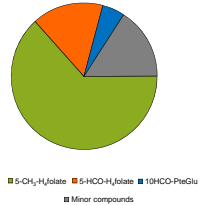


Folates (vitamin B9) are water-soluble vitamins, which are described to be sensitive to different physical parameters such as heat, oxygen, light, pH and leaching. However most studies on folate degradation during processing or cooking treatments were carried out on model solutions or vegetables only with thermal treatments. Our aim was to identify which steps were involved in folate losses in industrial processing chains, and which mechanisms were underlying these losses.

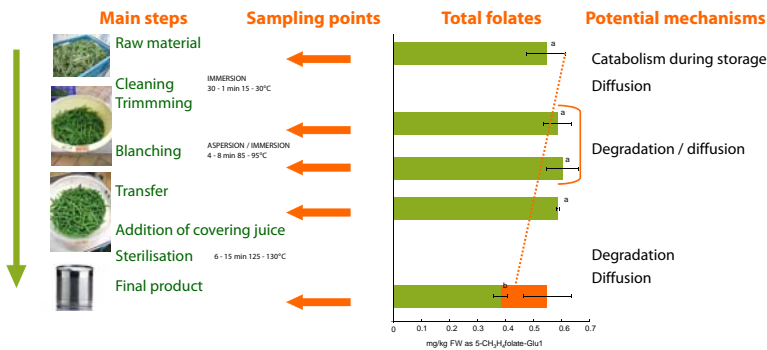


Structure of the folate vitamers



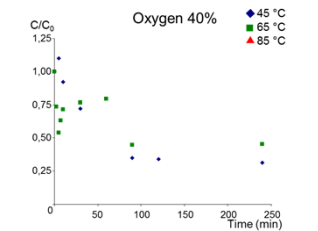
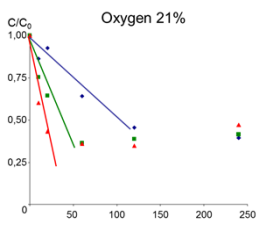
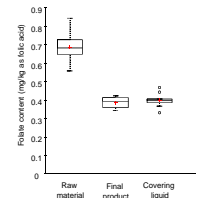
Main vitamers in green beans

Canning of green beans

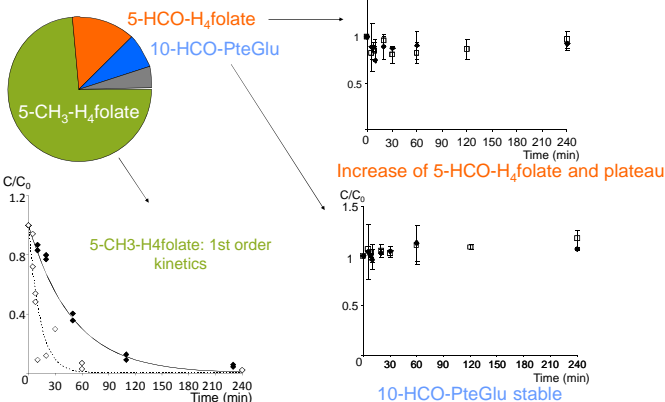


Folates were analyzed along an industrial canning chain (5 repetitions), at 5 sampling points. During industrial processing, folates contents decreased significantly, by 30% in green beans after sterilisation, with 20% of the initial amount being transferred into the covering liquid just after canning.

This loss and transfer to covering liquid was confirmed by analysis of raw materials, canned green beans and covering liquid 1 month after processing, over a production season.



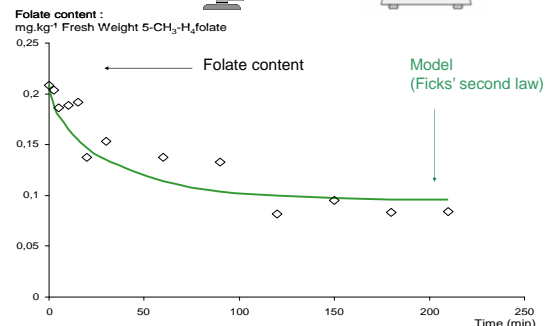
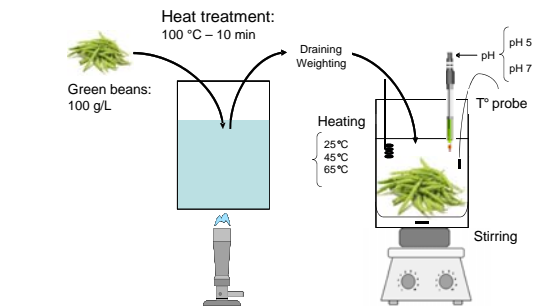
In green beans puree: initial speed increase with temperature, existence of a plateau.



Folate degradation kinetics was not monotonous in green beans especially at low temperatures (45 °C) and did not follow a first order reaction. The proportion of vitamers changed markedly after thermal treatment, with a better retention of formyl derivatives, while a pseudo-first order degradation was observed for 5-methyltetrahydrofolate in presence of oxygen.

Delchier N., Reich M. & Renard C.M.G.C.: Impact of cooking methods on folates, ascorbic acid and lutein in green beans (*Phaseolus vulgaris*) and spinach (*Spinacia oleracea*). *LWT-Food Science and Technology* 49 (2012) 197-201.
 Delchier N., Ringling G., Le Grandès J., Kouze-Werner D., Galland R., George S., Rychlik M. & Renard C.M.G.C.: Effects of industrial processing on folate content in green vegetables. *Food Chemistry* 139 (2013) 815-824.
 Delchier N., Ringling G., Magerneir J.-F., Rychlik M. & Renard C.M.G.C.: Mechanisms of folate loss during processing: diffusion vs heat degradation. *Food Chemistry*, in press.

Diffusion experiments



Folate diffusivity constant, calculated according to Fick's second law, was $5.8 \times 10^{-10} \text{ m}^2/\text{s}$ for green beans, which is the same order of magnitude as for sugars and acids in the vegetable considered.

The different folate vitamers show very different susceptibility to degradation, hence a more precise knowledge of folate composition is needed to understand folate loss. Leaching also plays a major role in folate loss. Limiting the contact between vegetables and both water and oxygen is desirable to limit folate losses during processing.