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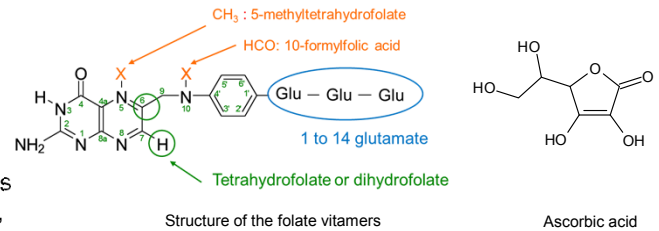
Reestimating the role of leaching for loss of water-soluble vitamins in processed vegetables

Catherine M.G.C. Renard, Nicolas Delchier, Hannah Brick, Caroline Garcia, Sylvie Bureau, Line Touloumet, Stéphane Georgé* & Jean-François Maingonnat

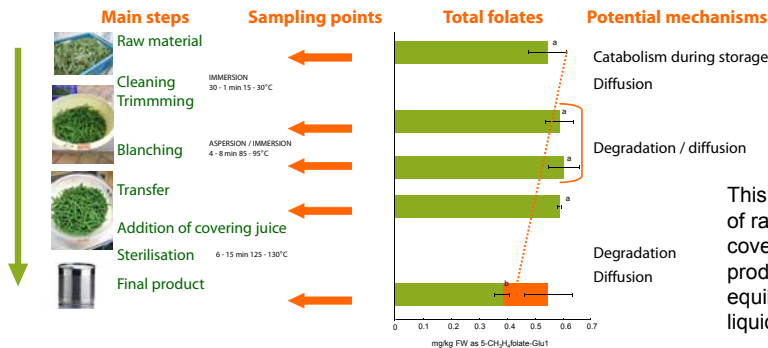
UMR408 "Sécurité et qualité des Produits d'Origine Végétale", INRA, Université d'Avignon, F-84000 Avignon, France
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Health benefits of fruit and vegetables are mainly linked to their contribution to the diet for fibers, minerals (K, Ca) and vitamins, especially vitamin C (ascorbic acid), vitamin B9 (folate) and provitamin A (carotenoids). Vegetables in particular, are almost systematically consumed after processing, whether industrial (freezing, canning...) or domestic (boiling, steaming, microwaving...). Two mechanisms explain water-soluble vitamins losses from vegetables during heat-treated in presence of water, namely degradation and leaching.

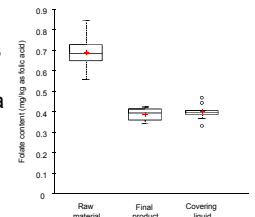


Canning of green beans – losses of folate through diffusion to the covering liquid



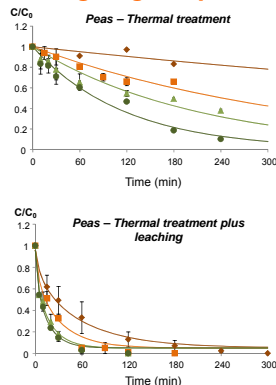
Folates were analyzed along an industrial canning chain (5 repetitions), at 5 sampling points. During industrial processing, total folate content decreased significantly, by 30% in green beans after sterilization, with 20% of the initial amount being transferred into the covering liquid just after canning.

This loss by transfer was confirmed by analysis of raw materials, canned green beans and covering liquid 1 month after processing, over a production season: concentrations were equilibrated between vegetable and covering liquid, with limited chemical degradation.

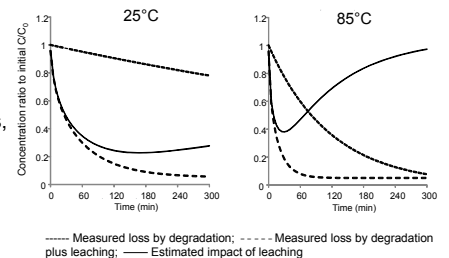


Chemical degradation and leaching for green peas and brussel sprouts

Losses in vitamin C were followed in fresh peas and Brussel sprouts, submitted to the same thermal treatment either sous-vide (hermetically sealed pouches) or immersed in water in open nets. This allowed to compare the losses due to thermal degradation and to leaching.

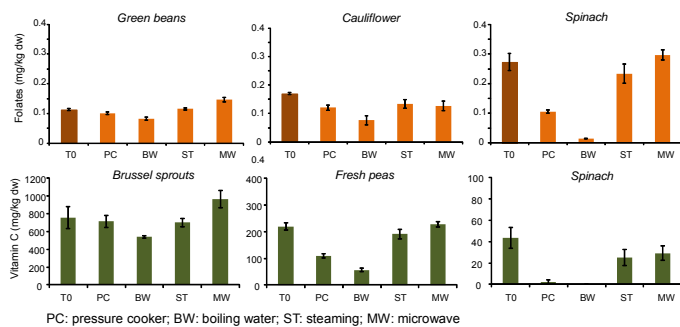


Much higher losses were observed when the vegetables were in contact with water, specially for peas, the smaller vegetable



Fick's second law and first order degradation kinetics models were used to quantify the relative impact of the two mechanisms.

Domestic cooking of frozen vegetables



Impact of common domestic cooking practices was assessed for frozen vegetables. Higher losses were observed for cooking in boiling water for both vitamin C and folates and for all vegetables.

Leaching is highly relevant to water-soluble vitamins losses when heat treatments occur in presence of water or a covering liquid. Leaching takes place particularly at the start of any heating step. This is modulated by vegetable's shape and size and temperature. Quantifying losses in water-soluble vitamins therefore requires more emphasis on the determination of diffusion parameters.

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 (*Spinacea oleracea*). *LWT-Food Science and Technology* 49 (2012) 197-201.
Delchier N., Ringling C., Le Grand J., Aouadi-Werner D., Galland R., Georgé 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 C., Maingonnat J.-F., Rychlik M. & Renard C.M.G.C.: Mechanisms of folate loss during processing: diffusion vs heat degradation. *Food Chemistry*, in press