Track 11/SubTrack 11-5: Probiotic foods and beverages

Probiotic vegetable foods containing health promoting molecules.

F. Valerio, S. L. Lonigro, M. Di Biase, Sisto, A. De Bellis P., M. Dekker, P. Lavermicocca

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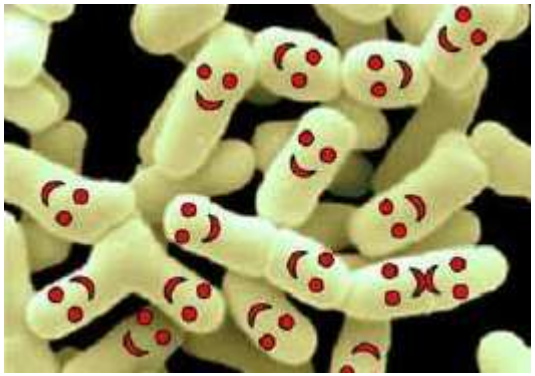
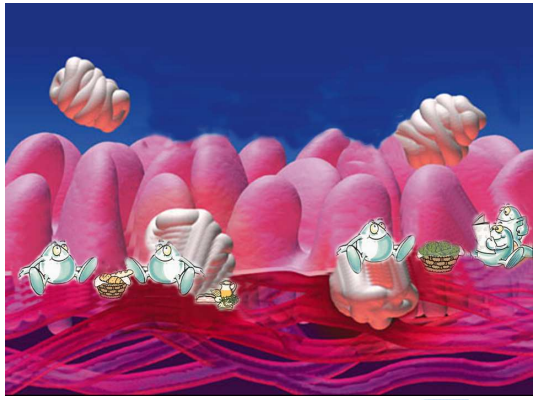
Vegetables as carriers of probiotic cells and bioactive compounds



The functional benefits of probiotic vegetable foods are linked to the presence of health promoting molecules - polyphenols, glucosinolates, vitamins, monounsaturated fatty acids, prebiotic sugars, etc. - as well as to the high count of live probiotic cells able to colonize the human gut (Lavermicocca *et al.*, 2005; Valerio *et al.*, 2011).

The use of a probiotic strain as a starter can allow the consumption of probiotics in fermented vegetables as an alternative to the milk-based products.



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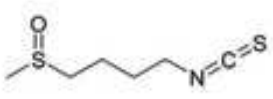
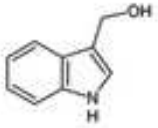
Secondary Plant Metabolites

Some examples from > 10,000 compounds:

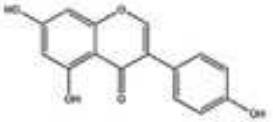
Broccoli *Sulphoraphane*



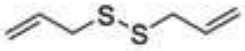
Cabbage *SIndole-3carbinol*



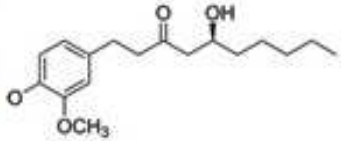
Soybeans *Genistein*



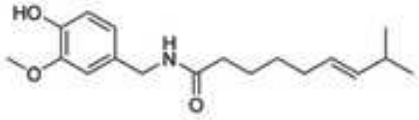
Garlic *Diallyl sulphide*



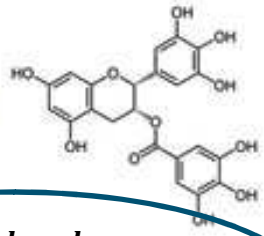
Ginger *Gingerol*



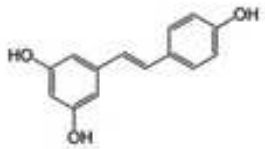
Chilli peppers *Capsaicin*



Green Tea *Epigallocatechin-3gallate*

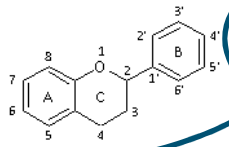


Grapes *Resveratrol*

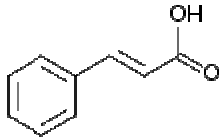


Tomatoes *Lycopene*

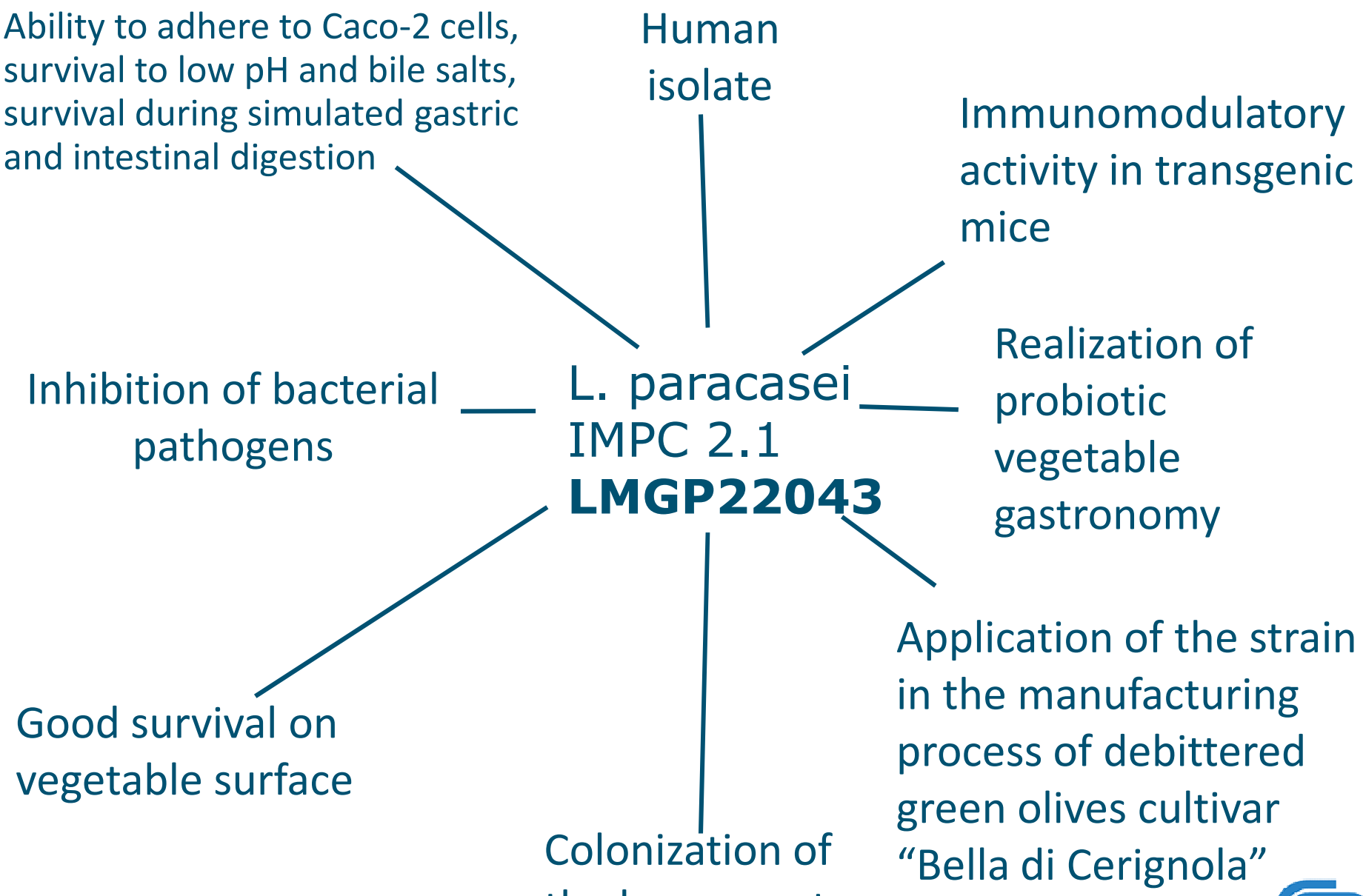
Olives ***polyphenols***



Artichokes ***hydroxycinnamic acids***



Support the survival of the probiotic *L. paracasei* LMG P22043



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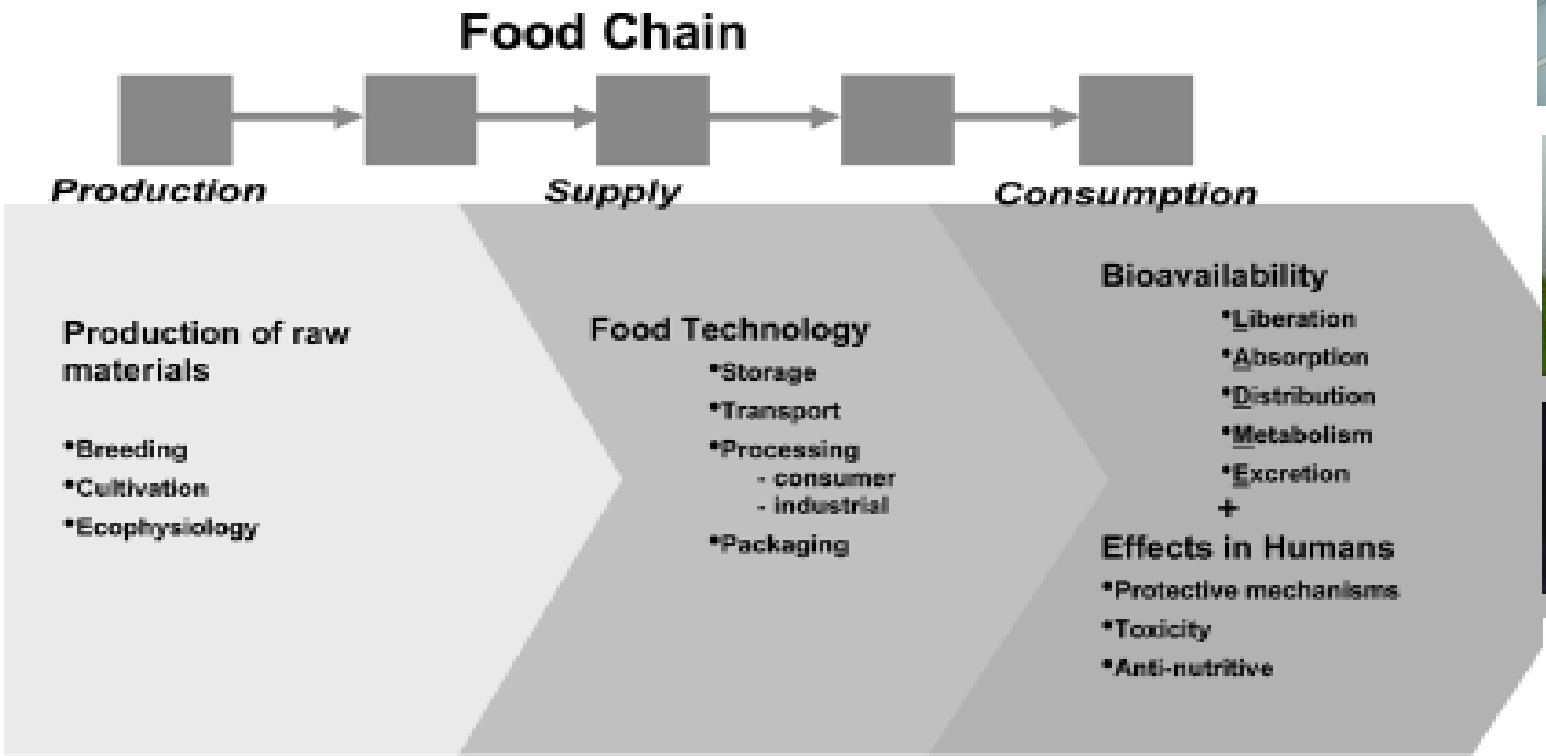
Vegetables as probiotic carriers

The efficacy of a probiotic food mainly depends on the ability of the probiotic strain to survive during processing and/or to compete with metabolically active microorganisms occurring in the food



L. paracasei LMG P22043 during vegetable processing

Contents lists available at ScienceDirect

International Journal of Food Microbiology

journal homepage: www.elsevier.com/locate/ijfoodmicro

Probiotic table olives: Microbial populations adhering on olive surface in fermentation sets inoculated with the probiotic strain *Lactobacillus paracasei* IMPC2.1 in an industrial plant

Palmira De Bellis, Francesca Valerio, Angelo Sisto, Stella Lisa Lonigro, Paola Lavermicocca *

Journal of Food Science

Bioprotection of Ready-to-eat Probiotic Artichokes Processed with *Lactobacillus paracasei* LMGP22043 against Foodborne Pathogens

Vol. 78, Nr. 11, 2013 • Journal of Food Science M1757

Francesca Valerio, Stella Lisa Lonigro, Mariaelena Di Biase, Silvia de Candia, Maria Luisa Callegari, and Paola Lavermicocca

Brassica vegetable as a carrier for delivering probiotic cells into the gut

1. Cabbage (*Brassica oleracea* var. *capitata*) is a cruciferous vegetable.
2. Glusosinolates (GSs): secondary plant metabolites with anticancer effect (Kim & Park, 2009; Steinbrecher et al, 2009):
3. The GS content and pattern will differ between varieties, but depend also on breeding location and conditions.
4. Sauerkraut: spontaneous or started lactic acid fermentation of shredded and salted white cabbage, which allows a rapid decline in pH of the product and prevents spoilage .
5. Traditional fermentation of cabbage (sauerkraut): no detectable GSs left in final product

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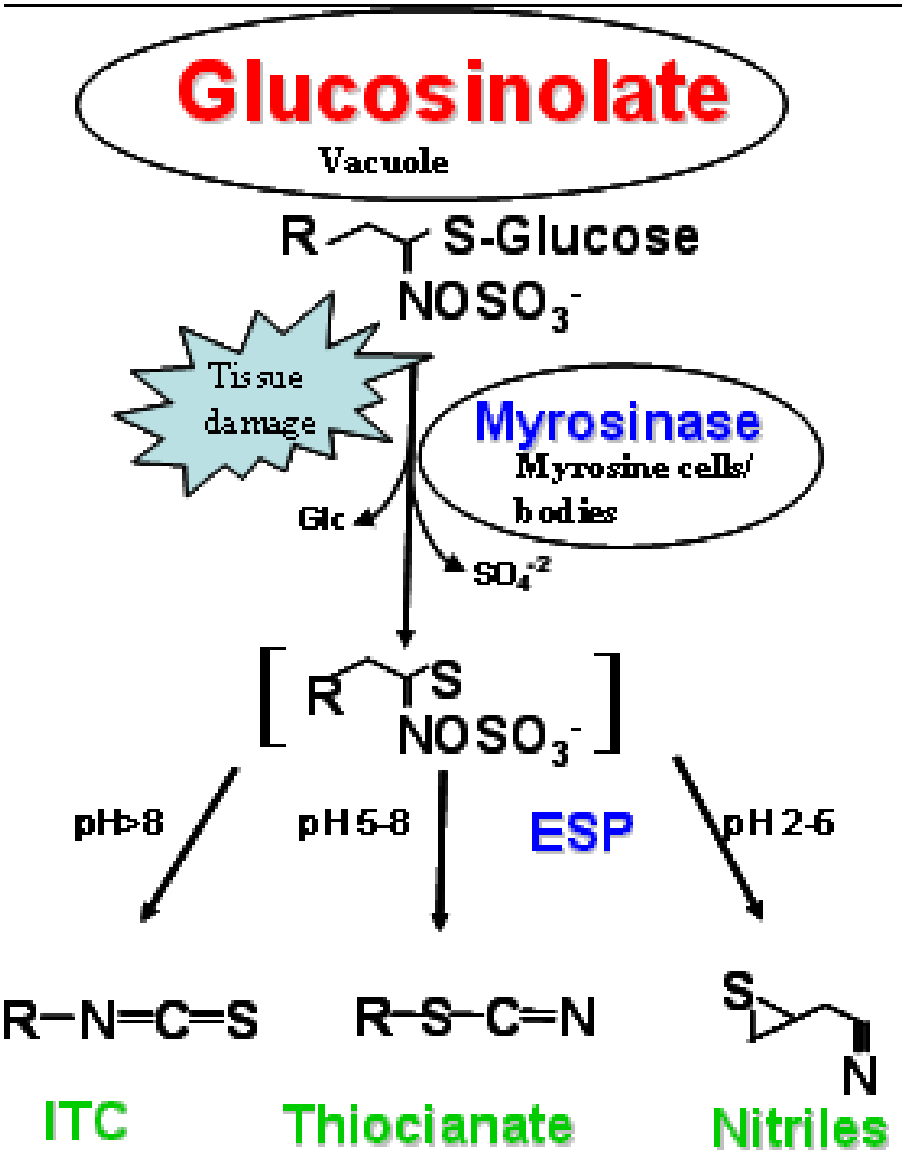
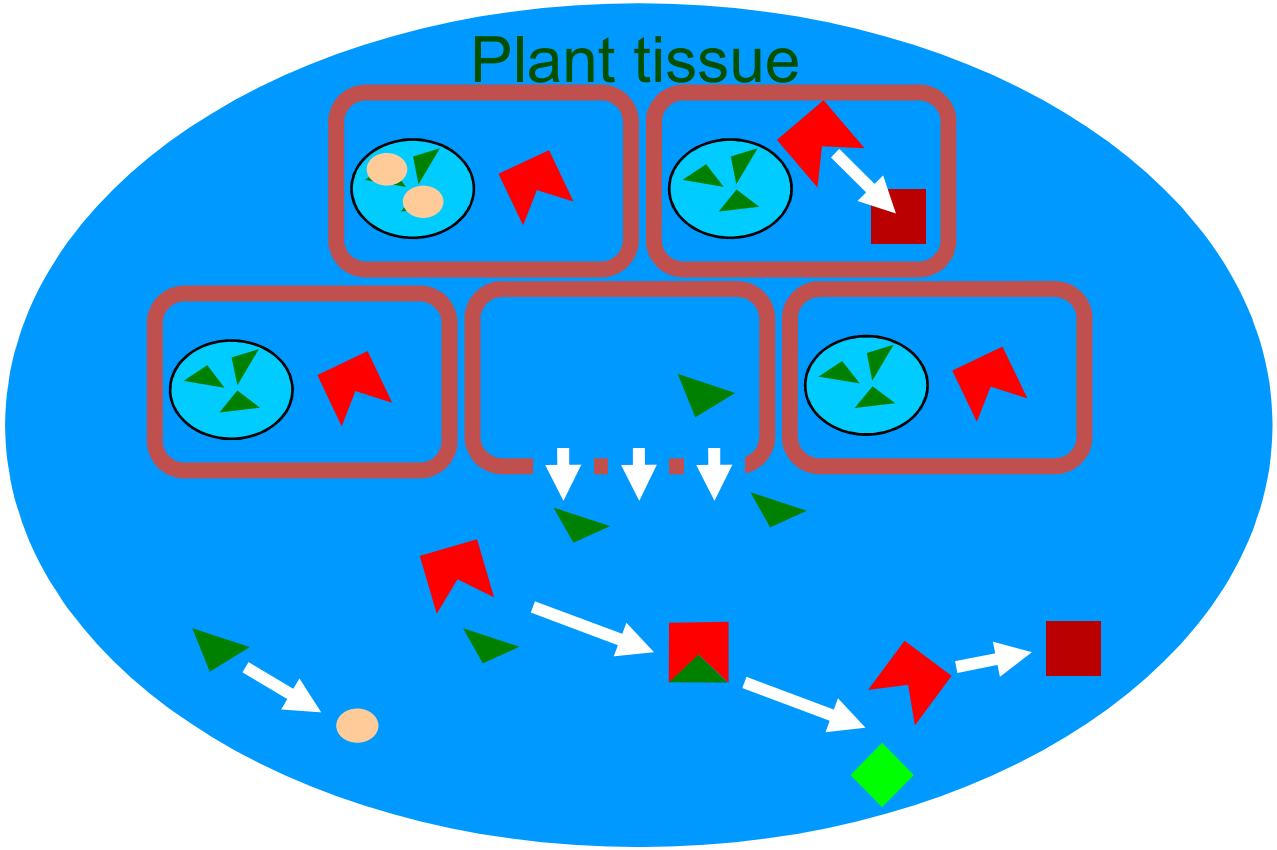
Glucosinolate's hydrolysis



up to 40% of ingested GSs can be hydrolyzed by the human gut flora as well (Fahey *et al*, 2012) and the bioactive breakdown products can enter the human body.

Isothiocyanates (ITC) recognized as bioactive compounds

Glucosinolate loss during processing

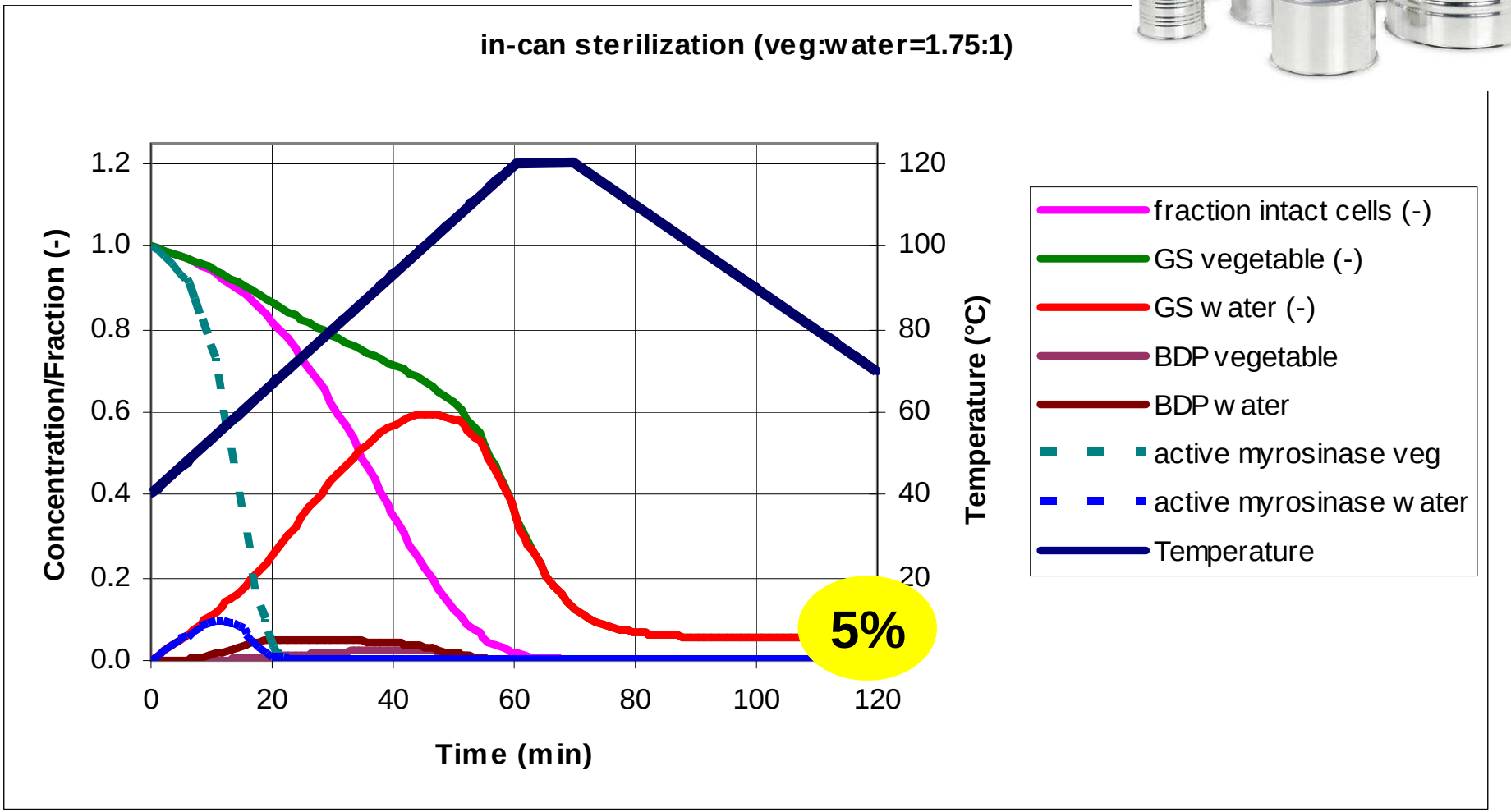


Processes affecting GSs

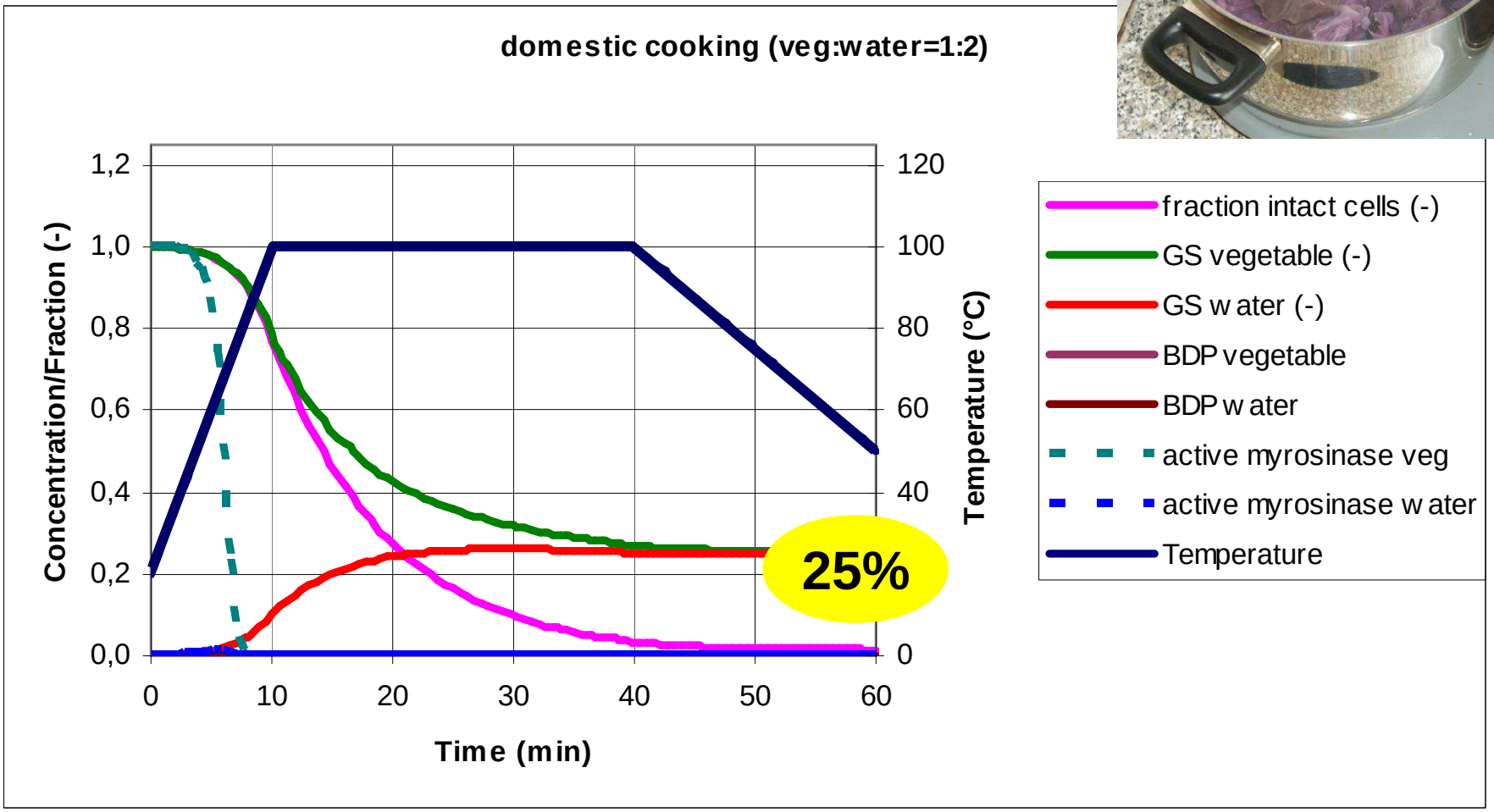
Initially:
Cell lysis
Diffusion of enzymes
Diffusion of GSs
Enzymatic GSs hydrolysis

At higher T:
Enzyme denaturation
GSs degradation

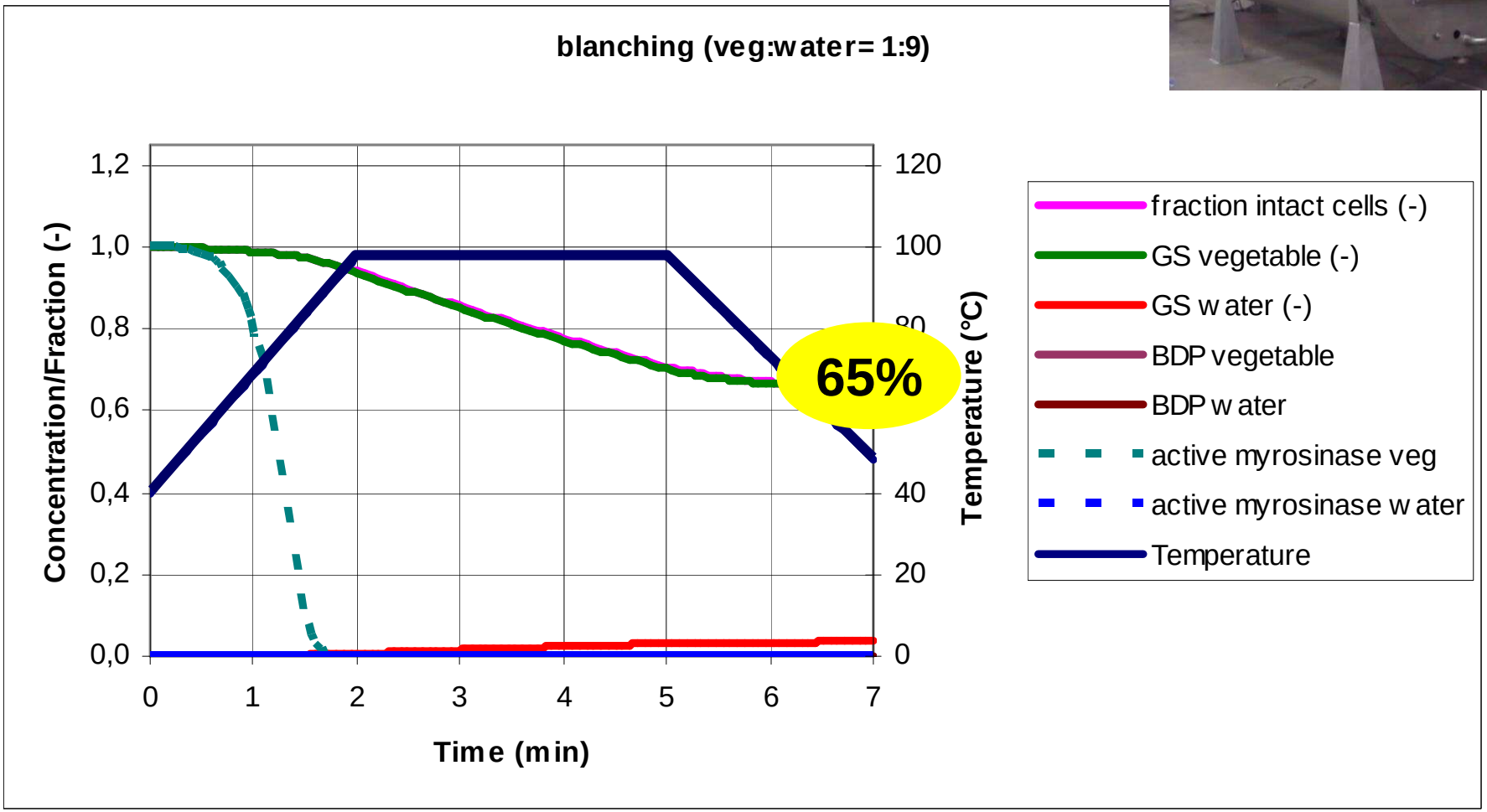
Process Simulation



Process Simulation



Process Simulation



Probiotic Fermented Cabbage with GSs

- Develop a 'functional' sauerkraut!
  - Containing probiotic bacteria
  - Containing GSs

- Assumption:
  - Endogenous myrosinase is cause of GS loss
  - Blanching can inactivate myrosinase
  - Blanching can reduce the presence of contaminants
  - Probiotic strain can be added after blanching and before fermentation

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Behaviour of *L. paracasei* LMGP22043 during storage of blanched white cabbage and fate of GSs content

cooking at 100°C for 5 min **BLANCHING**

Inactivation of myrosinase

•Inoculum with *L. paracasei* ($1x10^5$ CFU/g) (4% brine)

Growth kinetic at *25°C*

•Cabbage drained from brine after fermentation (71 h) vacuum packed and stored at 4°C

•Glucosinolate content

•*L . paracasei* monitoring

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L. paracasei LMG P22043 growth during blanched cabbage

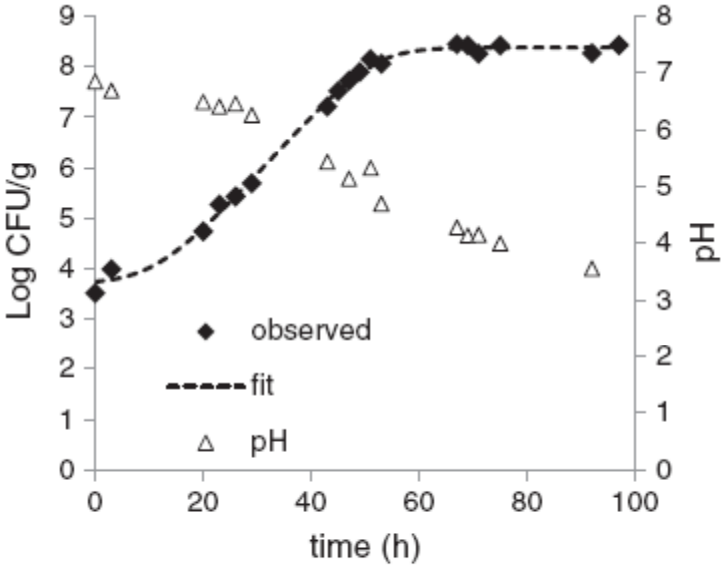

Fig. 1. Growth curve at 25 °C of the strain *Lactobacillus paracasei* LMG P22043 inoculated at 5 $\log_{10}$ CFU/g of cabbage and relevant pH values.

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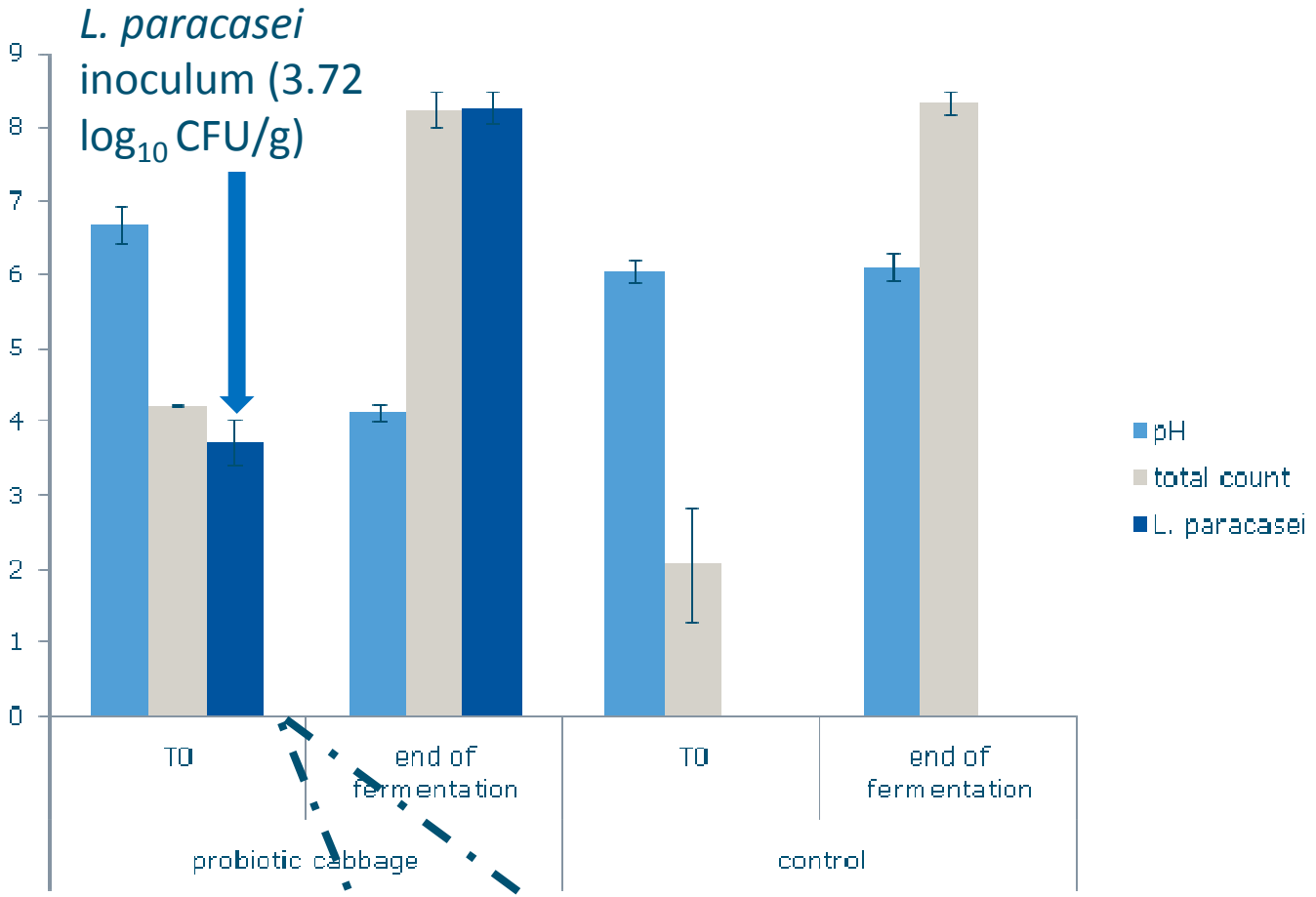
FERMENTATION OF BLANCHED CABBAGE

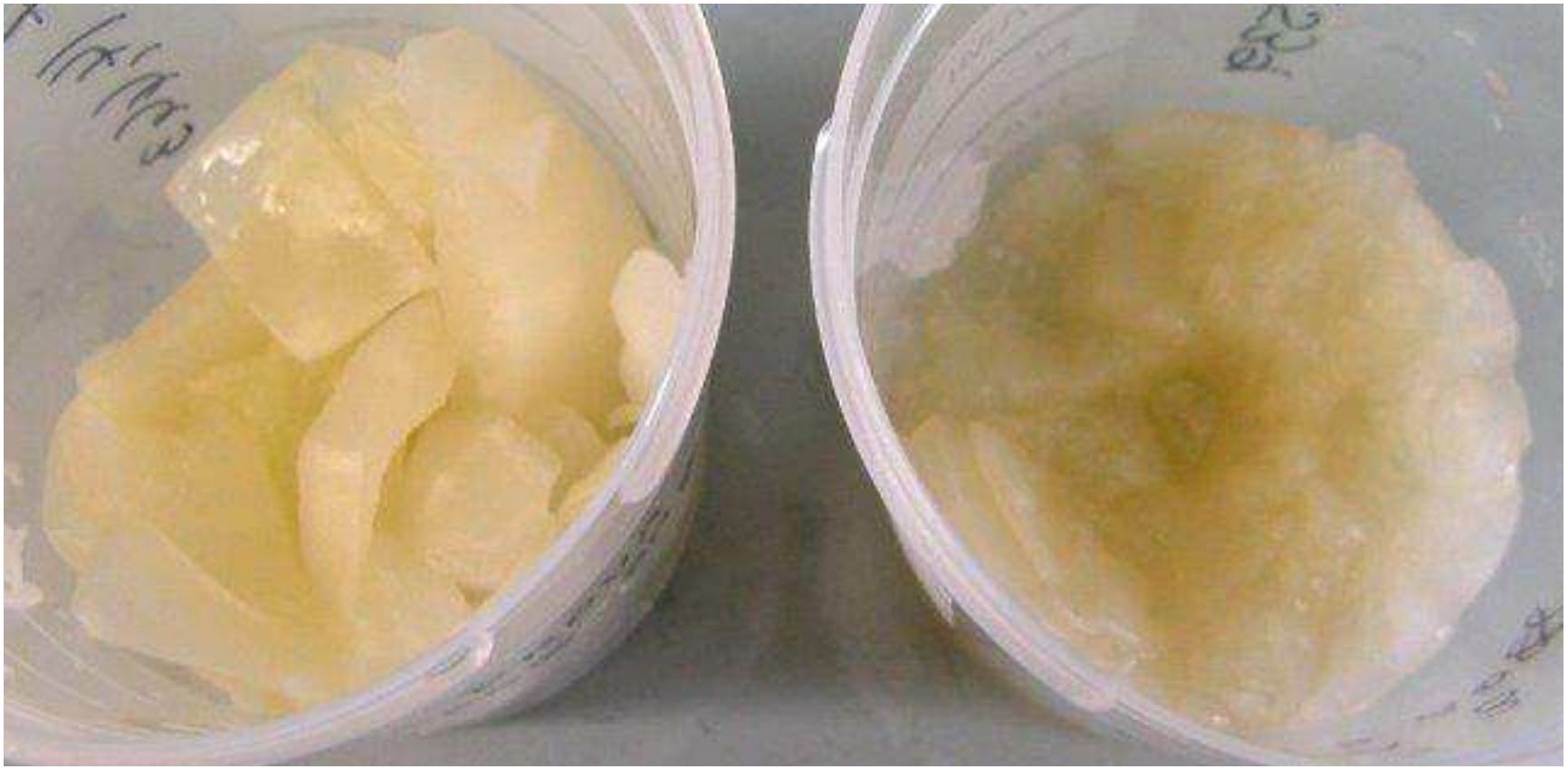
LOW pH VALUES

GOOD FINAL QUALITY



Inoculum load 1000 times lower than that usually used in industrial practices for vegetable fermentation

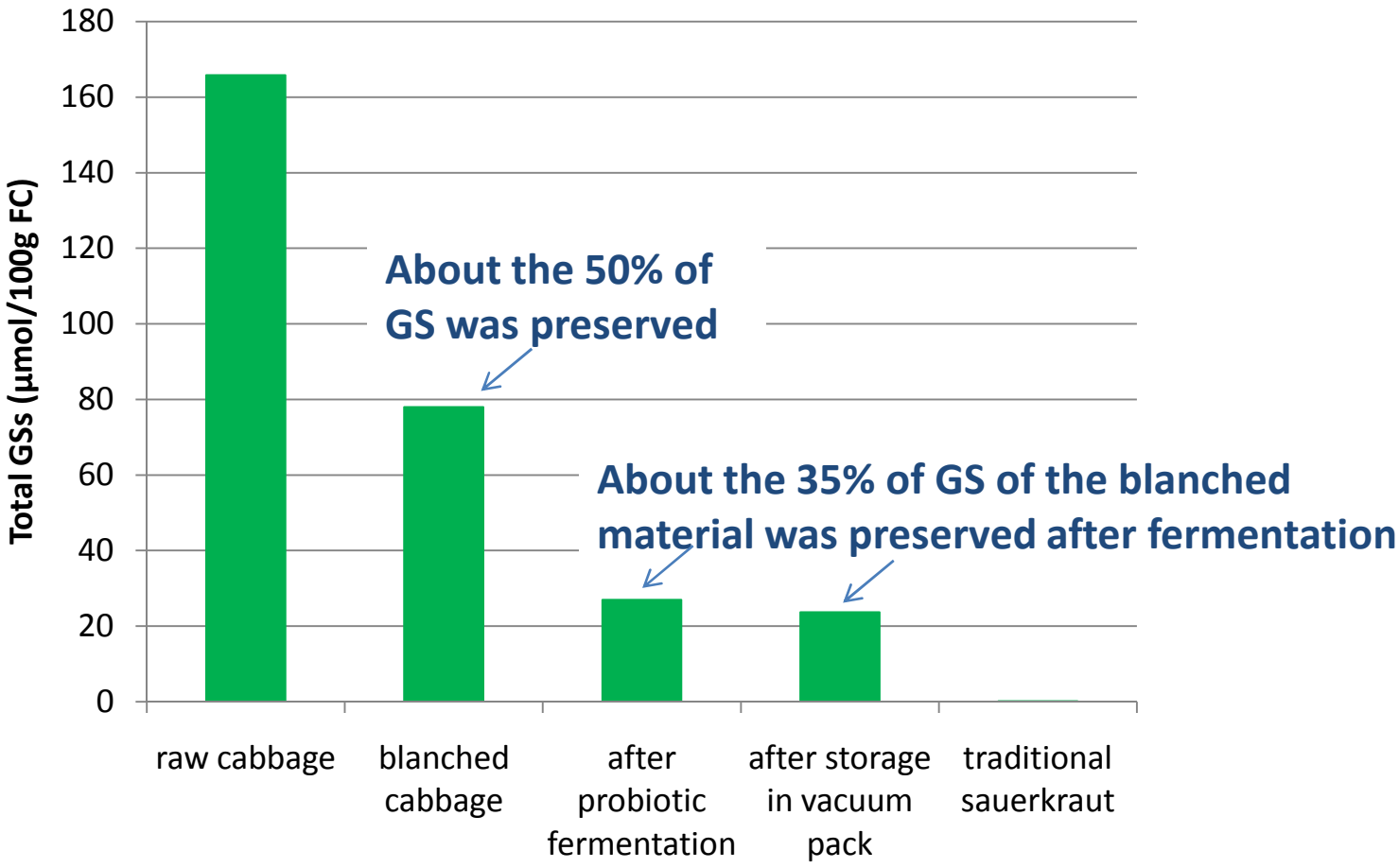
Probiotic survival in vacuum packed cabbage during refrigerated storage



Probiotic cabbage

Control

Glucosinolate content



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Food Research International 54 (2013) 706–710

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Brassica vegetable
Lactobacillus paracasei

ing a high content of phytochemicals in combination with a high count of live probiotic bacterial cells.

Conclusions

- Glucosinolates (GSs) are important for human health and cabbage is a rich source
- Processing affects the GSs content
- Traditional sauerkraut does not retain GSs
- Inactivating cabbage myrosinase retains GSs during fermentation
- A probiotic bacteria can be used to ferment blanched cabbage
- The final probiotic sauerkraut contains an adequate amount of live probiotic cells which can ensure a daily consumption of 9 log cfu of cells
- **A 'functional' sauerkraut is produced containing both GSs and probiotics!**

Questions?