HIGHTECH EUROPE

Activity of actinidin as plant milk clotting enzyme controlled by high pressure processing

Actinidin and high pressure

Identification

Key words	actinidin, proteolytic activity, dairy, high pressure, milk, cheese, kiwi fruit, clotting, coagulation, high pressure processing
Latest version	2010/12/22
Completed by	ttz

How does it work?

Primary objective	controlled clotting of milk using plant protease instead of chymosin, which is produced by genetically modified microorganisms
Working principle	Plant proteolytic enzymes such as actinidin, a sulfhydryl protease from kiwi fruit, can be used as milk clotting enzymes for dairy products. For this application, one requirement is the control of the proteolytic activity. Inactivation of the enzymes after milk clotting is achieved by high pressure (HP) technology. This technology allows the regulation of enzymatic activity at low temperatures.
Images	
Additional effects	inactivation of enzymes at low temperatures => reduces influences on texture and flavour production of yellowish cheese (HP ≥ 800 MPa)
Important process parameters	Scientific papers about the usage of actinidin as milk clotting agent are rare, but so far best results, concerning organoleptic characteristics and short coagulation time, were received with the following parameters:total solids (25 %), pH (6.49), actinidin activity (0.35 U/min)
Important product parameters	Scientific papers about the usage of actinidin as milk clotting agent are rare, but so far best results, concerning organoleptic characteristics and short coagulation time, were received with the following parameters: pressure (600 MPa), temperature (40°C), time (35 min) However, process conditions with other parameters (35 °C, 650 MPa, 25 min) were also tested as suitable for dairy products. Best results are received with homogenized full-fat milk.

What can it be used for?

Products	homogenized milk to prepare dairy products like fresh cheese and yoghurt
Operations	structure forming and texture stabilizing

Solutions for short comings	replacement of proteases produced by genetically modified organisms which raise ethical concerns, especially in the organic food sector replacement of other chymosin alternatives which are difficult to regulate (e.g. due to high pressure stability) which results in the release of bitter peptides leading to off-flavour (e.g. papain and ficin).

What can it NOT be used for?

Products	Any other than dairy products non-homogenized milk
Operations	
Other limitations	High pressure (≥ 800 MPa) can cause colour change of the final product (yellowish). High cost of HP processing for low added value product such as dairy products. Appliance of non-homogenized milk tends to fat and whey separation in the final product.
Risks or hazards	No risks

Implementation

Maturity	pilot scale
Modularity /Implementation	high pressure unit needed
Consumer aspects	Actinidin can be an allergen. Specifically, people allergic to latex, papayas or pineapples are likely to also be allergic to products using kiwifruit protease. Future experiments are planned to reduce actinidin activity by high pressure.
Legal aspects	Food enzymes should be approved and used only if they fulfil the criteria laid down in REGULATION (EC) No 1332/2008. EU: Novel Food approval for products treated with high pressure for most applications not required, no declaration or labelling required
Environmental aspects	Inactivation of enzymes with HP technology is less energy consuming than heat inactivation by thermal pasteurization.

Facilities that might be interesting for you

Title	Institute/company
HP FRIP unit	FRIP
HP Industrial scale IRTA	IRTA
HP Labscale IRTA	IRTA
HP lab-scale multivessel equipment KU Leuven	KU Leuven LFT
HP lab-scale single-vessel equipment KU Leuven	KU Leuven LFT
HPHT lab-scale multivessel equipment KU Leuven	KU Leuven LFT
HPP Pilot system DIL	DIL
HPPS Labscale System FBR	Wageningen UR - FBR
HPPS Pilot System FBR	Wageningen UR - FBR

Further Information

Institutes	NTU Athens, UAB
Companies	Resato, Hiperbaric
References	1. Katsaros, G., Katapodis, P., Taoukis, P. (2009). Modeling the effect of temperature and high hydrostatic pressure on the proteolytic activity of kiwi fruit juice. Journal of Food Engineering 94, 40-45. 2. Katsaros, G., Katapodis, P., Taoukis, P. (2009). High hydrostatic pressure inactivation kinetics of the plant proteases ficin and papain. Journal of Food Engineering, 91, 1, 42-48. 3. Katsaros, G., Tavantzisa, G., Taoukis, P. (2010). Production of novel dairy products using actinidin and high pressure as enzyme activity regulator. Innovative Food Science & Emerging Technologies 11, 1, 47-51. 4. Pastorello, E., Conti, A., Pravettoni, V., Farioli, L., Rivolta, F., Ansaloni, R., Ispano, M., Incorvaia, C., Giuffrida, M., Ortolani, C. (1998). Identification of actinidin as the major allergen of kiwi fruit. Journal of Allergy and Clinical Immunology 101, 4, 531-537. 5. REGULATION (EC) No 1332/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on food enzymes and amending Council Directive 83/417/EEC, Council Regulation (EC) No 1493/1999, Directive 2000/13/EC, Council Directive 2001/112/EC and Regulation (EC) No 258/97 Official Journal of the European Union L 354/1-9.