Ice binding proteins in psychrophilic bacteria – function, isolation, characterization and application in foods

Summary

Ice binding proteins (IBP) are natural polypeptides that are produced by organisms living in cold environments to prevent ice crystal growth and re-crystallization. Several food spoiling microbes are able to grow at refrigerator temperatures 2-6oC, therefore close to zero (or as alternative <-20oC) temperatures are preferred for long time storage. Technically, if exclude chilled storage on ice decreasing temperature to melting point is challenging as it might cause freezing damage of due to the time-spatial temperature fluctuations. A solution to the problems related to ice formation in chilled and frozen products might be adding ISPs. Our collaboration partner has recently screened 60 psychrophilic bacterial cultures isolated and found a strain (probably Pseudomonas fluorescens) capable of secreting IBPs. The main goal of PhD thesis is to investigate the potential of using Pseudomonas fluorescens IBP for improving quality and storage time of refrigeted and frozen food. For that purpose, PhD student will characterize the growth and excretion of IBPs by respective strains of Pseudomonas, isolate the protein, and establish its DNA and protein sequence, the structure and the mechanisms of action in food storage conditions.

Research field:	Chemistry and biotechnology
Supervisors:	Toomas Paalme Katrin Laos
Availability:	This position is available.
Offered by:	School of Science Department of Chemistry and Biotechnology
Application deadline:	Applications are accepted between June 01, 2020 00:00 and July 03, 2020 23:59 (Europe/Zurich)

Description

Psychrophilic bacteria can synthesize special proteins that modulate the growth of ice crystals and are generally called ice binding proteins (IBPs). To date, a wide variety of organisms were found to produce IBPs: fish, plants, bacteria, fungi and insects. IBPs, with their unique properties of thermal hysteresis (TH) and ice recrystallization inhibition (IRI), have become one of the promising tools in industrial applications like cryobiology, food storage, and others. However, the commercial potential of IBPs has remained largely unexplored despite great promise. So more experimental studies should address these fundamental and technological challenges in systematic manner. However, what is the structure and activity of IBPs depend on producing organism. In this PhD work we concentrate on the characterization of IPB excreted by Pseudomonas fluorescence.

First, to obtain sufficient amount of IBP to initiate the studies, the culture conditions are optimized for IBP production by Pseudomonas fluorescence. As alternative, the potential sequences of ISP in Pseudomonas fluorescence genome are expressed in E. coli. IBP-s is purified chromatographically and studied for IBP-activity. Produced in one or other way mechanisms and activity of ice recrystallization inhibition will be studied in model systems as well as during food storage at sub-zero temperatures. For applications, it will be essential that the IBP remain active during prolonged periods of time. For some uses any added IBP may also need to withstand heat treatment (pasteurization), low or high pH and ionic strength. So the stability of the IBPs thermal hysteresis and ice recrystallization inhibition activities will be studied.

The model systems include both chilled and frozen dough, as well as ice cream. The pre-prepared dough technology has served as a suitable approach to make fresh products available for retail stores. Although the technology is able to keep the dough products in a fresh state, more experimental evidence shows that a number of physical and chemical phenomena affect the qualities of the final product in a mostly negative way occur, such as an increasing in fermentation time and decreasing in specific volume when compared to fresh dough products. A few studies investigated the influence of IBPs on wheat dough, but to best of our knowledge there is no information available how IBP influence the pre-prepared rye dough during storage. The objective of this study is to investigate the effect of IBPs on characteristics of refrigerated and frozen rye dough including the fermentation properties and the texture properties of steamed rye bread as well as on shelf life.

Responsibilities and tasks

The PhD student will be responsible for planning and conducting all the necessary research activities related to topic of the current thesis, and which lead to the publication of minimum three papers in the peer-reviewed journals (in at least one of which being the first author) by the end of nominal studies time 4 years after matriculation.

Qualifications:

- Candidates should have Master degree in food technology, biotechnology or -physics
- Skills in structural analysis, gene technology, advanced instrumental analysis are recommended
- Food technology/biotechnology background, knowledge on food physics, and experience in food quality characterization

To get more information or to apply online, visit https://taltech.glowbase.com/positions/53 or scan the the code on the left with your smartphone.