Osmotic Treatment in Food Processing

FAIR CT 96 1118

23 - 24 June 2000
Karlsruhe, Germany

Poster Session

CELLULAR RESPONSE OF PLANT TISSUE DURING THE OSMOTIC TREATMENT WITH SUCROSE, MALTOSE, AND TREHALOSE SOLUTIONS

M. Ferrando and W.E.L. Spiess
Federal Research Centre for Nutrition, Karlsruhe, Germany

Both quality of the plant product and its mass transport properties are closely related to tissue structure. At cellular level, plasma membrane plays an outstanding role as a selective barrier during the first stages of the osmotic treatment (OT). As long as the tissue membranes are intact, osmosis will be the mechanism controlling the process, becoming the plasma membrane the major resistance to mass transfer. Several functional properties (e.g. texture, colour, rehydration behaviour) of the osmo-treated product will depend on to which extent the plasma membrane has been damaged through processing.

The effect of the nature of the solute on the structural changes undergone by the plant tissue due to cellular shrinkage and loss of membrane integrity is still unclear. Some disaccharides -maltose, sucrose, and trehalose- seem to play a significant role in preserving the membrane functionality in the dry state. The protective effect of trehalose, however, has been mainly investigated on products directly blended with this disaccharide before drying. OT using trehalose solutions is a means to impregnate tissue pieces with a simultaneous dewatering.

Sucrose, trehalose and maltose solutions were employed in order to study their effect on plant tissue structure. The cellular shrinkage and cell viability of two plant tissues of different complexity such as cortex tissue of strawberry (var. Elsanta) and onion epidermis (var. Martina) were monitored during the treatment. In case of onion epidermis, the cellular behaviour during rehydration was also investigated.

Cellular shrinkage of onion epidermis was significantly faster for sucrose treatment and short processing times –up to 15 minutes-. During rehydration, protoplasts pre-treated with trehalose showed a significant higher swelling. Cell viability was not affected by OT in any case.

In strawberry tissue (var. Elsanta), no significant differences on the cellular shrinkage and viability of protoplasts were found regarding to the disaccharide employed. The cell viability showed to be more dependent on the concentration rather than the sort of solute. Cell viability – ratio of living cell number at any time to the initial living cell number - declined down to 0.84±0.11 and 0.25±0.15 through 40% and 60% (w/w) sucrose solution treatment.

DIRECT OSMOTIC CONCENTRATION OF TOMATO JUICE

Konstantinos Matsos, Konstantinos Petrotos, Eleftherios Poirazis and Harris N. Lazarides
Aristotle University of Thessaloniki, Department of Food Science and Technology, Laboratory of Food Processing and Engineering, Box 255, 54006 University Campus, Thessaloniki, Greece

ABSTRACT

A pilot scale, direct osmotic concentrator of flat configuration was developed, to study direct osmotic concentration of liquid foods. The concentrator was fit with a reverse osmosis type membrane of variable thickness, placed on a support material. Sodium chloride (NaCl) solutions of various concentrations were used as osmotic media. Experimental parameters included: feed flow rate, trans-membrane pressures of fluids, temperatures of fluids, operation time. The impact of these parameters on water permeation flux was monitored. Through preliminary experimentation with tomato juice, the technical feasibility of direct osmotic concentration of real food systems was examined. The preliminary experiments were successful. Preliminary results are presented in this paper. Based on findings of preliminary experiments, thorough experimentation with model fluid systems is underway.

INCREASING THE SWEETNESS OF BRAMLEY'S SEEDLING APPLES

Andrea Friese, Ronan Gormley and Martine Brennan
Teagasc, The National Food Centre, Dublin 15

Bramley's seedling apple is not often used in fruit salads as it lacks sweetness. The aim of this research was to osmotically sweeten apple slices by soaking them in sucrose solution. Bramley's Seedling apples from a commercial store were cut into 7 mm thick slices and cored. Slices were soaked in 60% (w/v) sucrose solution, in a ratio of 1:10, product:solution, at 20°C without agitation. Samples were removed every 15 min up to 1 h and tested for weight, dry matter, colour (Hunter meter L whiteness and b yellowness), soluble solids (refractrometry), shear value of 50 g samples (Kramer style T-2000 Texture System) and taste panel ranked preference. The treatment increased apple sweetness but was detrimental to texture and colour. The highest rate of change in soluble solids, dry matter, weight and colour (L/b) was in the first 15 min. Tasters preferred samples soaked for 15 or 30 min and least preferred unsoaked slices. Taking all parameters into account, the optimum soak period under the conditions studied was 15 - 30 min.

OSMOTIC DEHYDRATION AS A PRE-TREATMENT IN COMBINED MICROWAVE-HOT-AIR DRYING

H.M. Torringa[1], U. Erle[2]

Osmotic dehydration can be used as an effective method to remove water from vegetable tissues while simultaneously introducing solutes in the product. Generally osmotic dehydration will not give a product of sufficient low moisture content for it to be considered shelf-stable, so it is used in combination with other drying techniques like hot-air drying, freeze-drying and vacuum-drying. Within the framework of an European concerted action FAIR-CT96-1118 part of the research is focused on further processing of the osmosed product by applying volumetric microwave dehydration in a vacuum environment. Motivation for applying combined osmotic and microwave dehydration as a pre-treatment are:

- more homogenous heating by microwaves from modified dielectric properties by the solute uptake for instance less overheating of the central parts of concave shaped mushrooms in microwave drying,
- possibility to produce unique products with better taste,
- improved flavour characteristics and/or increased nutritional value, prevention of oxidation of the product and colour stabilisation and improvement of the texture of the product such as higher final bulkvolume of the product compared to heated air dehydration or microwave dehydration without osmotic pre-treatment.

Mushrooms, apples and strawberries are osmotically dehydrated with different solutes and subsequently dried with microwaves. Heat and mass transfer characteristics are investigated such as drying curves and temperature profiles within the product. Quality properties of the final product are assessed: vitamin C retention, shrinkage, porosity and rehydration properties. The results show that combined processing of osmotic and microwave dehydration gives several advantages both from a technological and a consumer point of view.

[1]Agrotechnological Research Institute (ATO-DLO), P.O. Box 17, 6700 AA Wageningen, The Netherlands; [2]Institut für Lebensmittelverfahrenstechnik, Universität Karlsruhe, Kaiserstr. 12, D-76128 Karlsruhe, Germany

COMBINED TECHNIQUES TO IMPROVE THE QUALITY OF PROCESSED BERRY FRUITS TO BE USED AS INGREDIENT IN COMPLEX FOODS.

Authors: Marco Dalla Rosa, Dino Mastrocola, Paola Pittia, Davide Barbanti, Giampiero Sacchetti

ABSTRACT

The interest on fruit ingredients to be used as inclusion in complex food as dairy products, ice-creams and bakery foods is strongly increased in the past decade. The industry need is to have the availability of fruit pieces mantaining as well as possible original colour, flavour and texture of the fresh fruit, but suitable to be included in formulation. For these reasons and also because of economical aspects the inclusion of fresh fruit is scarcely used in the industrial processing of non-fruit based food. In this work air drying, osmotic dehydration as stand-alone processes and a combination of air-drying followed by osmotic treatment (impregnation after partial dehydration instead of the more common osmo-convective drying where the osmotic treatment preceeds the air-drying) were carried out on Strawberry halves and Blueberry samples to obtain semi-moist products to be used as ingredients in complex food, i.e. dairy products and bakery foods. Air-drying and osmotic dehydration mass transfer kinetic parameters were determined and compared with the kinetic data obtained by the coupled air-drying-osmotic treatment process in order to reach a prefixed threshold of water activity, considered as key parameter to permit compatibility between food basis and ingredients. By using the osmotic dehydration process or even more the coupled air-drying-osmotic treatment (dehydro-osmodrying) the desired lowering of water activity happens at higher water content than in the stand-alone air-drying process.