Water, citric acid, phosphoric acid, oxalic acid, acetic anhydride and maleic anhydride were evaluated for their effectiveness in degumming crude canola, soybean and sunflower oils. Citric acid was shown to be the best degumming reagent in terms of significantly reducing phosphorus and iron levels in the three crude oils while at the same time producing a food grade lecithin with potentially useful emulsifying properties. Thin layer chromatography revealed that the composition of canola and soybean lecithins produced by water degumming did not vary greatly from lecithins obtained by chemical degumming. Lecithins prepared by water degumming produced the most stable oil in water emulsions. Those lecithins prepared by citric acid, acetic and maleic anhydride treatments produced slightly less stable emulsions but showed good potential as emulsifying agents.

COMPARISON OF STARCH GELATINIZATION KINETICS IN POTATOES RESISTANT AND SUSCEPTIBLE TO LOW TEMPERATURE SUGAR ACCUMULATION. M.J. Leszkowiat*[1], R.Y. Yada[1], R.H. Coffin[2] and D.W. Stanley[1], [1]Department of Food Science, University of Guelph, Guelph, Ontario N1G 2W1; [2]Agriculture Canada, University of Guelph, Guelph, Ontario N1G 2W1.

Starch gelatinization activation energies (Ea) for tubers of low temperature sugar accumulation (LTSA) resistant seedling, ND 860-2, and LTSA susceptible cultivar, Norchip, were determined using differential scanning calorimetry. Two Ea's, corresponding to gelatinization above and below 67.5°C, were measured at harvest and after 3 weeks storage at 5° and 10°C. Ea and chip colour were affected by time-temperature regime and cultivar. Freshly harvested ND 860-2 had a low temperature range Ea which was 30% higher than Norchip. ND 860-2 stored at 5°C yielded acceptable chip colour whereas Norchip did not. LTSA resistance may be related to starch granule structure which is reflected in differences in gelatinization activation energies.

A TEM EXAMINATION OF AMYLOPLASTS FROM POTATOES RESISTANT AND SUSCEPTIBLE TO LOW TEMPERATURE SUGAR ACCUMULATION. M.J. Leszkowiat*[1], R.Y. Yada[1], R.H. Coffin[2] and K. Baker[3], [1]Department of Food Science, [2]Agriculture Canada, [3]Department of Environmental Biology, University of Guelph, Guelph, Ontario N1G 2W1.

Storage parenchyma tissue from the potato cultivar Norchip (susceptible to low temperature sugar accumulation (LTSA)) and the seedling ND 860-2 (resistant to LTSA) were prepared using 3 different fixative procedures and examined using transmission electron microscopy at harvest and after 3 weeks storage at 5 and 10°C. Of the fixative procedures examined, 2.5% (v/v) glutaraldehyde in 0.07M phosphate buffer (pH 7.3) was selected based on general ultrastructural preservation. Micrographs indicated no apparent difference in membrane ultrastructure between the two samples at harvest and after storage, in which amyloplasts were surrounded by a continuous, intact double membrane. Storage of tubers at both 5° and 10°C, however, resulted in a loosening of the amyloplast membrane which was likely the consequence of senescence. Low temperature sweetening in potatoes, therefore, does not appear to be the result of membrane distingregation.

NATURE OF WHITE DEPOSIT ON PICKLED GREEN ASPARAGUS. T. Fuleki, Horticultural Products Laboratory, Horticultural Research Institute of Ontario, Vineland Station, Ontario L0R 2E0.

Small but highly visible white and greyish-white deposits appeared on commercially pickled green asparagus (c.v. Viking) spears after about 6 months storage. Microscopic examination revealed that the deposit consisted mainly of white needle shaped crystals. Rutin (quercetin 3-rhamnoglucoside), a flavonol compound present in asparagus in appreciable quantities (0.02 to 0.1%) was suspected of being responsible for the deposits found on pickled asparagus. To verify this, the deposit was co-chromatographed with authentic rutin using HPLC. The analysis revealed that the major component is rutin.

LIGNIFICATION OF *ASPARAGUS OFFICINALIS*. J.L. Smith* and D.W. Stanley, Department of Food Science, University of Guelph, Guelph, Ontario N1G 2W1.

Raw and blanched asparagus were studied to determine the time course of lignification and whether non-enzymatic polymerization and/or synthesis of lignin precursors could proceed. Samples were stored at 22 C, 4 C and -10 C and were tested at 24 h, 48 h and 30 day intervals, respectively. Assays indicated no enzyme activity in the blanched samples throughout the study; Warner Bratzler shear and % crude fiber data showed an increase in toughness. Toughening occurred at a slower rate and to a lesser extent in the unblanched control. Light microscopy (bright field and fluorescence) and scanning electron microscopy revealed deposition of tentatively-identified lignin in secondary cell wall elements of both samples.

APPLICATION OF THE CYCLONE BIOREACTOR SYSTEM TO THE MICROBIAL PRODUCTION OF FLAVOURS. M. Gardner*[1], D. Gardner[1], C.L. Duitschaever[2], [1]W.H.E. Process Systems Ltd., 100 Klondike Drive, Weston, Ontario, [2]Department of Food Science, University of Guelph, Guelph, Ontario N1G 2W1.

The recent consumer trend towards natural food additives has directed research into the area of microbially derived products. Flavour active components which may be obtained through fermentation include acids, alcohols, lactones, esters, aldehydes and ketones. Since most volatiles are secondary metabolites, regulation of environmental conditions within the fermentor is critical to product fermentation. The selection of a suitable bioreactor system (fermentor and controls) may play a key role in achieving a commercially viable process. The application of the cyclone fermentation system to the production of a variety of natural flavours will be discussed. Compounds of interest include: (1) acetaldehyde (characteristic of citrus flavour and aroma); (2) gamma-deca lactone (fruity aroma of peaches); (3) diacetyl (butter flavour). Preliminary results are presented, emphasizing process design, economics and potential for commercial scale-up.

SELECTION AND OPTIMIZATION OF BIOREACTORS FOR MICROBIALLY DERIVED FOOD INGREDIENTS. D. Gardner*[1], M. Gardner[1], N. Kosaric[2], [1]W.H.E. Process Systems Ltd., Weston, Ontario M9L 1X3; [2]Faculty of Engineering Science, University of Western Ontario, London, Ontario N6A 5B9.

A wide range of bioreactor designs are available to the food industries for the microbial production of ingredients and additives. Criteria for the selection of a fermentor were reviewed. Key parameters in reactor optimization were studied. A novel bioreactor design, the cyclone fermentor was chosen for evaluation and commercialization. The design features simultaneous aeration-agitation with a centrifugal pump and recirculation loop. Optimization studies focussed on oxygen transfer and mixing rates as performance indicators. Dimensional analysis was employed to aid in experimental design, to evaluate data, and provide scale-up correlations. High rates of mixing and mass transfer are obtained with low operating and capital costs. The design is cost effective in the production of a variety of compounds. Advantages are best demonstrated in the fermentation of insoluble substrates (hydrocarbons, edible oils) and fermentations with highly viscous broths (i.e. filamentous fungi).

BONE AS A POSSIBLE SUPPORT MATERIAL FOR THE IMMOBILIZATION OF ENZYMES. B. Manji*[1], R.Y. Yada[1] and C.J. Findlay[2], [1]Department of Food Science, University of Guelph, Guelph, Ontario N1G 2W1; [2]Bioprotein Canada Inc., 1 West Avenue South, Hamilton, Ontario L8N 2B9.

Despite the obvious technological advantages, the adaptation of immobilized enzyme systems to commercial food processes has been limited due to the cost of capital equipment and raw materials, instability of biocatalysts and the inability of many common support materials to withstand high flow rates in continuous reactors. Animal bone possesses many of the characteristics desired in a support matrix for immobilization such as non-toxicity, abundance, high mechanical strength and porosity. This paper will review some of the commonly used support materials as well as discuss the feasibility of utilizing bone as a solid support material for enzyme immobilization.