



## The use of enzymes in carrot processing

- Enzyme for the production of cloud stable carrot juice concentrate
- Increased yields (20-60% higher)
- Facilitates extraction by decanters

### BACKGROUND

Enzymes can be used to assist the production of cloud-stable carrot juice, resulting in greater maceration and solubilization of the vegetable tissues, higher yields of juice, with more dissolved solids, improved clarity and reduced viscosity of the juice and less insoluble waste.

The rigid structure of vegetables such as carrot comes from their tough cell walls made with interwoven strands of structural carbohydrates such as cellulose and pectin. It requires a carefully tailored product comprising pectinases, cellulases and other carbohydrase enzymes to break down these structural polymers and release the valuable components within.

More recently Biocatalysts has developed a new enzyme that gives even higher yields called Depol™ 692L.

### DEPOL™ 692L, A NEW IMPROVED ENZYME FOR CARROT JUICE EXTRACTION

Depol™ 692L is our most aggressive enzyme for macerating plant tissues. It was developed to specifically aid carrot juice extraction processes. In tests Depol™ 692L released more solids and provided a higher yield of juice than all other enzymes tested and can more than double the yield of juice extracted. Depol™ 692L is a very broad spectrum carbohydrase based on our proven product Depol™ 40L. The enzyme's unique activity comes from its ability to remove ferulic acid esters which have been described as the rivets holding plant cell walls together, in combination with other broad spectrum carbohydrases .

Depol™ 692L can be used in a variety of processes such as the production of vegetable boullion, to give significantly higher maceration of plant tissues, increased product yield, improved solubilization of complex polymers and reduce insoluble waste.

*Depol™ 692L is GRAS status and conforms to the FCC/FAO/WHO/JECFA recommendations for food grade enzymes. All dose rates suggested in this bulletin are to be used as a guide only; it is recommended that clients perform their own evaluation in the plant. Biocatalysts will be pleased to provide assistance with quality and process evaluations and applications of our product.*



## PROCESS DESCRIPTION

The extraction of juice from carrots, unlike some other vegetables, is a very demanding process which requires proper handling to reduce unwanted chemical oxidation and maintain cloud stability. As shown in Figure 1, the carrots are ground after cleaning and peeling (optional). To prevent enzymatic browning, the blanching should be as quick as possible.

One option is to use direct steam injection for rapid heating. Acid is added at the grinding or heating stage to bring the pH to 5-5.2. This acidification results in optimum enzyme reaction and prevents colour deterioration. Water can also be added at this stage to facilitate handling of the slurry and juice extraction. The slurry is cooled to about 30-50°C for optimum enzyme action; this can be achieved by vacuum cooling.

For yield improvement and to facilitate extraction, Depol™ 40L or Depol™ 692L is added (200-300ppm of Depol™ 40L or Depol™ 692L, on carrots). This will result in an approximate yield of 50-70kg of juice solids (in the finished concentrate) per tonne of raw carrots processed, compared to 35-45kg solids without the use of enzymes. A 20-60% yield improvement is not uncommon.

The enzyme costs are nominal in relation to the higher juice solids recovery. Normal carrot juice is too viscous to be concentrated beyond 36° brix. With the use of Depol™ 40L or Depol™ 692L, the carrot juice can be concentrated up to 70° brix, if so desired. The enzymes added for yield improvement also serve to reduce viscosity. For viscosity reduction alone Depol™ 40L or Depol™ 692L could be added in the surge tank after pressing or decanting. The time and temperature available at this stage will determine the dose requirements of the enzyme.

**TABLE 1. DOSE AND APPLICATION OF DEPOL™ 40L FOR CARROT PROCESSING**

DOSE	APPLICATION
2000-5000 ppm	for maximum liquefaction
200-500 ppm	for yield improvement
20-50 ppm	for viscosity reduction

## DOSING

Different dose rates can be used for different applications as shown in Table 1 below. Actual time and temperatures of the contact will determine precise amount of enzymes to be used.

**TABLE 2. COMMON PROBLEMS ENCOUNTERED IN CARROT JUICE EXTRACTION**

PROBLEM	SOLUTION
Digestion taking longer than predicted	<ol style="list-style-type: none"> <li>1. Ensure carrot mixture is kept warm throughout the enzyme incubation and that temperature does not drop thus reducing enzyme efficiency.</li> <li>2. Check the pH of the carrot mixture and adjust to approximately pH 5.0 with citric acid if necessary.</li> <li>3. Try adding a higher dose of Depol™ 40L or Depol™ 692L.</li> </ol>
Enzyme not working	Ensure the enzyme has been added at the correct temperature and that direct heat has not denatured the enzyme rendering it ineffective.
Large chunks of carrot remaining untreated	The enzyme is not effectively getting into contact with the plant tissues. Try physically chopping or grinding the carrot into smaller fragments prior to adding the enzyme.
Low juice yield with old carrots	Carrots that have been stored or allowed to dry out will give lower yields of juice than fresh carrots. Try adding more water and extending the length of the enzyme incubation.

PRODUCTION PROCESS  
for the extraction of carrot juice

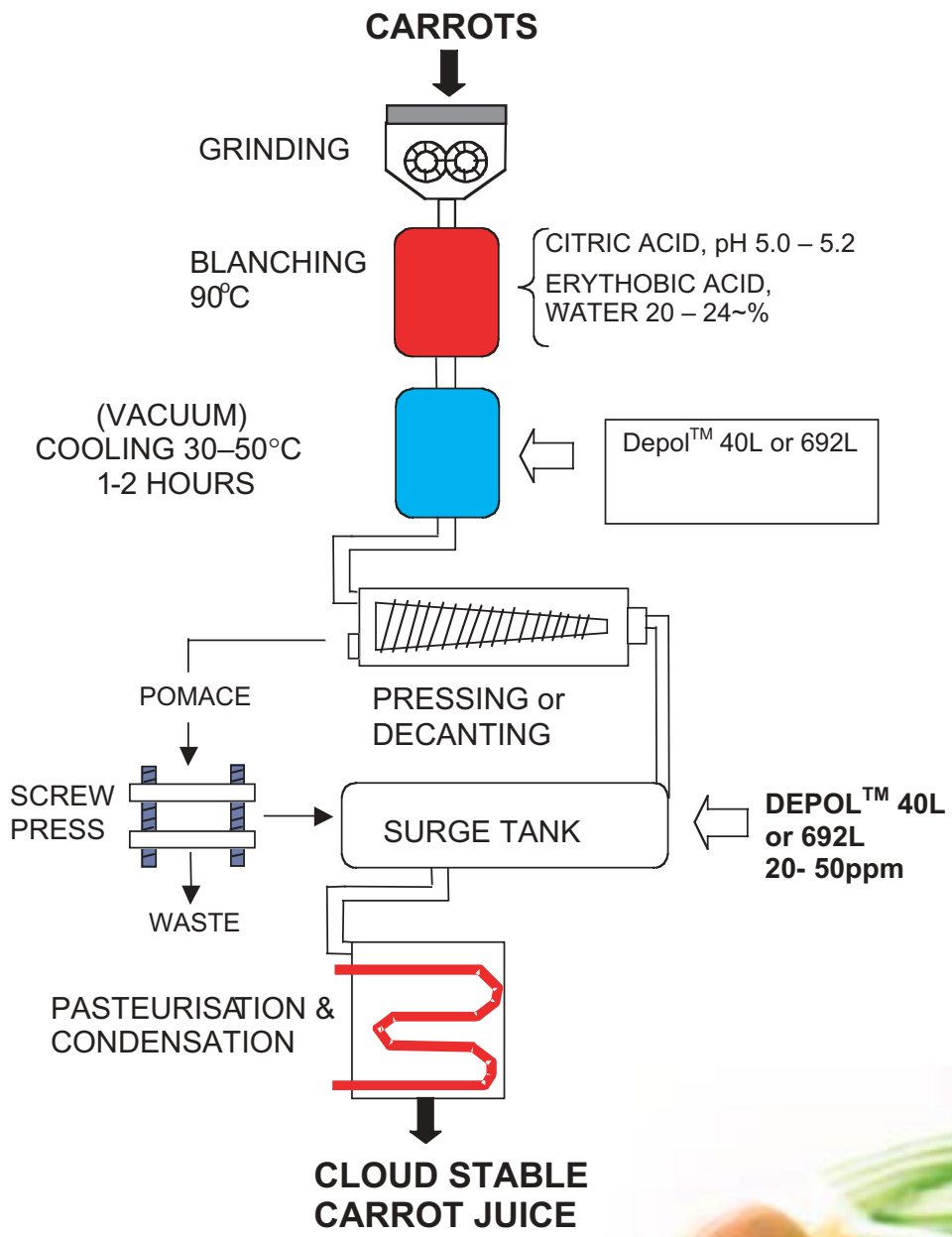


FIGURE 1

