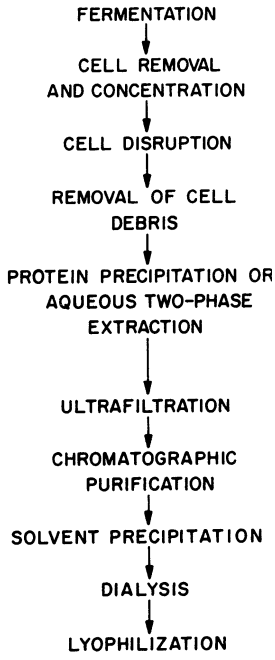

Figure 11.2. Major steps involved in the separation and purification of intracellular enzymes.

size and nature of the product, and a number of different methods may therefore need to be used for a fermentation broth containing soluble products of different molecular size. Figure 11.2 summarizes the major steps involved in the separation and purification of an enzyme from a fermentation broth, and this approach is generally applicable for many protein products.

The strategy in Fig. 11.2 can be generalized to involve four primary functions: (1) separation of insoluble products and other solids, (2) primary isolation or concentration of product and removal of most of the water, (3) purification or removal of contaminating chemicals, and (4) product preparation, such as drying. Process economics dictate that water must be removed very early in the process train so that the size of the equipment in the following steps will be minimized. Because a step designed primarily to concentrate product and the steps designed to remove contaminating chemicals often remove solvent, there is no distinct separation between steps 2 and 3. We will treat these steps by describing in the same section operations to recover soluble compounds. First, however, we consider those steps that remove solids, such as cells or the insoluble material.

11.2. SEPARATION OF INSOLUBLE PRODUCTS

The separation of solids such as biomass, insoluble particles, and macromolecules from the fermentation broth is usually the first step in product recovery. In some cases, the broth may need to be pretreated to facilitate solids separation. Examples of pretreatment are heat treatment, pH and ionic strength adjustment, and the addition of coagulants and