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Major Metabolic Pathways

5.1. INTRODUCTION

A major challenge in bioprocess development is to select an organism that can efficiently make a given product. Before about 1980 only naturally occurring organisms were available. With the advent of genetic engineering, it is possible to remove and add genes to an organism to alter its metabolic functions in a predetermined manner (*metabolic engineering*). In any case, the bioprocess developer must understand the metabolic capabilities of natural organisms either to use them directly or to know how to metabolically engineer them to make a desired, perhaps novel, product. Consequently, we turn our focus towards learning about some essential metabolic pathways.

Differences in microbial metabolism can be attributed partly to genetic differences and/or to differences in their responses to changes in their environment. Even the same species may produce different products when grown under different nutritional and environmental conditions. The control of metabolic pathways by nutritional and environmental regulation has become an important consideration in bioprocess engineering. For example, *Saccharomyces cerevisiae* (baker's yeast) produces ethanol when grown under anaerobic conditions. However, the major product is yeast cells (baker's yeast) when growth conditions are aerobic. Moreover, even under aerobic conditions, at high glucose concentrations some ethanol formation is observed, which indicates metabolic regulation not only by oxygen, but also by glucose. This effect is known as the *Crabtree effect*.