Chapter 13

Adjunct Cultures in Cheese Technology

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ABSTRACT

Cheese ripening involves highly complex biochemical events. Coagulant enzymes as well as the utilized starters play an important role in these events. Two types of starters are used: primary and secondary. The main role of the primary culture, which consists of lactic acid bacteria, is to carry out lactic production during fermentation. They contribute to proteolysis and limited flavor formation with the enzymes they possess. Secondary or adjunct cultures are used to develop the texture and to accelerate the ripening. During the selection of this type of culture, enzyme profiles (i.e., proteolytic and lipolytic activities and their autolysate levels) in cheese are the primary factors to be taken into consideration. Apart from these, the other factors are their positive effects on health, availability, and economy. Adjunct cultures include yeast, molds, and bacteria. Some of the heterofermentative lactobacilli species, in particular weakened strains, are used as adjunct cultures in order to accelerate the ripening and shorten the ripening time in fat-reduced and low-fat cheeses. This chapter explores adjunct cultures in cheese technology.

INTRODUCTION

Conversion of milk into cheese involves a series of complex biochemical reactions. These biochemical reactions are carried out either by indigenous microflora of milk or by selected defined microorganisms (Beresford et al., 2001). Defined lactic acid bacteria (LAB) which are also called starter culture, are usually added into milk prior to renneting and they give cheese characteristic aroma-flavour and texture. Fox et al., 2000, Parente & Cogan 2004). The primary function of starter culture is to generate lactic acid but they also have the following functions in cheese (Broome et al., 2003)

1. Production of aroma components such as acetic acid, acetaldehyde and diacetyl,
2. Suppression of the growth of pathogens by producing antimicrobial agents,
3. Allegedly promote human health if the culture carries probiotic properties,
4. Contribution to ripening due to rich enzyme systems.

The cheese starter cultures can be used as primary cultures which are primarily responsible for lactic acid production and formation of characteristic aroma/flavour and texture of the given cheese variety, or secondary (or adjunct) cultures which target to give cheese one or more specific function.

Primary cultures or lactic acid bacteria, are specifically selected microorganisms based on the characteristic aroma/flavor and texture of the cheese to be produced and incorporated into the cheese milk before cheese manufacturing. They are primarily responsible for lowering the milk pH during fermentation and generate required level of lactic acid. They are also rich in specific enzymes which are actively involved in ripening process of cheese, i.e. proteolytic, lipolytic or glycolytic enzymes Beresford et al., 2001, Parente & Cogan, 2004). In the cheese varieties made from raw milk no starter culture is added to milk. Some Spanish and Italian cheese are good examples of these varieties. In these varieties, indigenous or random (contaminant) microorganisms in the milk contribute to acid and aroma formation. Among the lactic acid bacteria species/subspecies used as primary starter cultures are; Lactococcus lactis (subsp. lactis, subsp. cremoris, subsp. lactis biovar. diacetylactis) Leuconostoc spp., Streptococcus thermophilus, Lactobacillus acidophilus, Lb. delbrueckii subsp lactis, Lb. delbrueckii subsp bulgaricus, Lb. helveticus and Lb. fermentum. Lactococcus lactis spp. are found in almost all cheeses. The thermophilic lactic acid bacteria species such as S. thermophilus, Lb. delbrueckii subsp. bulgaricus are used in varieties in which high heat treatment is applied during production, i.e. pasta-filata type cheeses. Species of Lb. casei, Lb. plantarum, Lb. salivarius, Enterococcus faecium, E. faecalis and even Staphylococcus can also be found mostly in artisanal Mediterranean cheeses (Powell et al. 2003, Parente & Cogan, 2004).

Adjunct cultures are not generally able to produce lactic acid and are employed together with primary cultures; however, they play an important role in ripening. Yeasts, molds and bacteria such as G. candidum, P. roqueforti, P. camemberti, D. hansenii, Brevibacterium linens, Propionibacterium freudenreichii, Corynebacterium, Staphylococcus, Micrococcus, and heterofermentative lactobacilli are frequently used as adjuncts (Chamba & Irlinger, 2004, Parente & Cogan 2004). Depending on the characteristics of the cheese, ripening may primarily develop on the surface of the cheese or inside the cheese block. For example, the formation of CO₂ in Emmental cheese, the development of blue veins in Blue cheese or the growth of velvet-like molds on the surface of Camembert cheese are the changes caused by the previously mentioned cultures. Though the primary cheese starter culture is used in Camembert cheese, the color, aroma and textural properties of the ripened cheese are formed by the metabolic activity of P. camemberti, which is completely used as an adjunct culture.

SECONDARY CULTURES

Most cheese varieties are produced from heat treated milk. This eventually causes changes in the indigenous flora of raw milk. In order to compensate the heat-triggered changes in cheese milk flora, cheese industry has put an effort in searching of new methods to provide consumers with products both reliable and with high organoleptic quality in a convenient ripening period. Among these methods, the use of adjunct culture seems to be the most promising one (El Soda et al., 2000, Fox et al., 2000).