CHAPTER -1

INTRODUCTION

1.1 Food Spoilage

Spoilage is the process in which original nutritional value, texture, flavor of food are damaged, such food become harmful to people an unstable to eat. Most foods deteriorate in quality following harvest, slaughter or manufacture, in a manner that is dependent on food type, its composition and storage conditions. Various external forces are responsible for the spoilage of food (Archer et al., 2004).

1.2 Food Spoilage by Bacterial Species

It is estimated that every year more than eighty one million people are affected by food borne illness every year. Illnesses such as food spoilage are becoming more common as our life styles change for one thing, we eat out more and more food is being prepared in advance. In developing countries like India, losses due to microbial spoilage have been estimated between 10-25% in various types of foods, which adds to the problems of acute shortage of food supply in these countries. We have no accurate figures on much food spoilage is the result of mishandling by the consumer (Gaze, 2005). The principles of food safety are easy to apply in the home, when eating in the outdoors, at your local shop when buying groceries, and even at a restaurant. Most food spoilage accidents results due to mishandling food keeping it at the wrong temperature, incorrect re-handling cross contamination (Suhrkl and Nielsen, 2004). The major type of pathogenic bacteria associated with foods are Salmonella, Clostridium Perfringes, Staphylococcus aureus, Listeria monocytogenes, Campylobacter jejuni, Bacillus cereus and Escherichia coli. Escherichia coli is a member of the family Enterobacteriaceae (Ewing et al., 1986), which consist of many genera, such as Shigella, Salmonella and Yersinia. Most strains of E.coli are not regarded as pathogens that cause infections (Gassama, et al., 2001). Most pathogenic strains are grouped under the following virotypes: enteroinvasive, enter aggregative and enter hemorrhagic (Ray et al., 2004). Bacillus cereus causes two different types of food spoilage: the 1 type and the emetic type, The 1 type of food spoilage is caused by an enterotoxin
produced during vegetative growth of *Bacillus cereus* in the small intestine while emetic toxin is produced by the cells growing in the food. The organism is unable to grow below 10°C (Liu and Yang, 2006).

*Clostridium perfringens* actually causes two different human diseases that can be transmitted by food, i.e., *Clostridium perfringens* type a food poisoning and necrotic enteritis caused by toxin produced by type C strain. *Staphylococcus aureus*, also known as ‘Golden Staph’ is important from both a medical and food perspective (Sivertsyik *et al*., 2007). It likes to grow in salty and sweet food like those containing clustered, ham, cake and other bakery product etc. The important thing to remember is that *Staphylococcus* produces a soft tissue infection, endocarditis (Liu *et al*., 2006). *Staphylococcus aureus* is commonly found in the nose and throat and on the hairs and skin of more than 50% of healthy individual (Bergdoll *et al*., 1979).

These microorganisms (molds and bacteria) do not cause disease but they spoil food by growing in the food and producing substances which alter colour, texture and odour of the food. For example souring of milk, growth of mold on bread, cake and rotting of fruit and vegetables (Voysey and Hammond, 1993). A general feature of microbial spoilage is its relatively sudden onset; it does not appear to develop gradually, day by day a little worse, but more often as an unexpected and unpleasant revelation (Adams and Moss, 2008).

Bakery products are subject to physical, chemical and microbiological spoilage. While physical and chemical spoilage limits the shelf life of low and intermediate moisture bakery products, microbiological spoilage by bacteria, yeast and molds is the concern in high moisture products (De Souza *et al*., 2008). Some of the major bacterial genera which cause food spoilage include *Staphylococcus, Bacillus, Escherichia, Shigella, Clostridium* and *Salmonella* (Madigan and Martinko, 2006). Dairy products with their high nutritional value and the presence of easily metabolized carbohydrates, fat and proteins provide ideal environments for microbial spoilage. Proteolysis and putrefaction are typical results of microbial spoilage of such high protein materials. In comparison with dairy and meat products, most fruits and vegetables have a much lower protein and fat content and undergo a different kind of spoilage (Harley and Klein’s, 2008). Undesirable microbes that can cause spoilage of dairy products include Gram-negative psychrotrophs, coliforms, lactic acid bacteria, yeasts, and molds (Tatini and Kauppi, 2003). The
low pH and the nutritional profile of most cheeses are favorable for the growth of spoilage yeasts. Surface moisture, often containing lactic acid, peptides and amino acids favors rapid growth. Many yeasts produce alcohol and CO₂, resulting in cheese that tastes yeasty (Horwood et al., 1987). Molds can grow well on the surfaces of cheeses when oxygen is present, with the low pH being selective for them. In packaged cheeses, mold growth is limited by oxygen availability, but some molds can grow under low oxygen tension. Molds commonly found growing in vacuum-packaged cheeses include *Penicillium* spp. and *Cladosporium* spp. (Hocking et al., 1992). *Penicillium* is the mold genus most frequently occurring on cheeses.

A measure of control in bakery products includes chemical preservatives that can control the growth of molds by preventing the metabolism, by denaturing the protein of the cell, or by causing physical damage to the cell membrane. Among these chemical preservatives propionic sorbic acid, sodium benzoate sodium metabisulphite or their salts which have been show to increase the shelf life of bakery products (Jay, 1992 and Bennions et. al., 1973). The use of sulphite as a preservative can trigger different allergic reactions in sulphite hypersensitive consumers. Symptoms such as asthma, urticaria, abdominal pains, nausea, diarrhea, seizures and anaphylactic shock resulting in death have been recorded. Additional severe side effects may result from the combination of sodium benzoate and sodium phenyl acetate includes severe headache, fainting, blurred vision, chest pains, slowed heartbeat, unresponsiveness and slurred speech (Gunnison et al., 1987). These health dangers have resulted in the need for using natural preservatives that can result in improving the quality of food.

Bacteriocins produced by lactic acid bacteria are found in numerous fermented and non-fermented foods. Bacteriocins are protein containing macromolecules which exert a bactericidal mode of action on susceptible bacteria (Tagg et al., 1976). Nisin, produced by *Lactococcus lactis*, is a well-characterized lantibiotic extensively used as a food preservative. It is a natural food preservative with high efficiency, nontoxic, and no harm to humans and free from side effects. Gram negative bacteria are resistant to nisin because their cell walls are less permeable than gram positive bacteria. Nisin is applied as a food preservative in over 50 countries and
areas all over the world. Stability of nisin in a food system during storage is dependent upon three factors: incubation temperature, length of storage and pH. (Delves-Broughton, 1990).

Reuterin is a broad spectrum antimicrobial substance produced by *Lactobacillus reuteri* during fermentation of glycerol. It is a water soluble active at a wide range of pH and resistant to proteolytic and lipolytic enzymes and it is therefore suitable for bio preservation. Reuterin which shows a potential inhibitory effect against a wide range of Gram-positive bacteria, e.g., *Bacillus cereus, Staphylococcus aureus* and *Listeria monocytogenes* and Gram-negative bacteria e.g., *Escherichia coli*, and *Pseudomonas* in synthetic media (Ziney et al., 1999). Nisin has inhibitory mode of action on wide range of gram positive bacteria and food borne pathogens but has a narrow spectrum of activity affecting primarily vegetative cells and spores of Gram-positive bacteria. An approach to broaden its spectrum could be its combination with other bacteriocins. So in this study we will check the effect of various different combinations of Nisin and Reuterin on the food spoilage in bakery products.