

# Chapter 3. Factors that Influence Microbial Growth

December 31, 2001

## Evaluation and Definition of Potentially Hazardous Foods

### 1. Introduction

The factors discussed in this section constitute an inclusive, rather than exclusive, list of intrinsic, extrinsic, and other factors that may be considered when determining whether a food or category of foods requires time/temperature control during storage, distribution, sale and handling at retail and in food service to assure consumer protection.

Many factors must be evaluated for each specific food when making decisions on whether it needs time/temperature control for safety. These can be divided into intrinsic and extrinsic factors. Intrinsic factors are those that are characteristic of the food itself; extrinsic factors are those that refer to the environment surrounding the food. The need for time/temperature control is primarily determined by 1) the potential for contamination with pathogenic microorganisms of concern (including processing influences), and 2) the potential for subsequent growth and/or toxin production.

Most authorities are likely to divide foods among three categories based on an evaluation of the factors described below: those that do not need time/temperature control for protection of consumer safety; those that need time/temperature control; and those where the exact status is questionable. In the case of questionable products, further scientific evidence--such as modeling of microbial growth or death, or actual microbiological challenge studies--may help to inform the decision.

### 2. Intrinsic factors

#### 2.1. Moisture content

Microorganisms need water in an available form to grow in food products. The control of the moisture content in foods is one of the oldest exploited preservation strategies. Food microbiologists generally describe the water requirements of microorganisms in terms of the water activity ( $a_w$ ) of the food or environment. Water activity is defined as the ratio of water vapor pressure of the food substrate to the vapor pressure of pure water at the same temperature (Jay 2000b, p 41):

# Chapter 3 Factors That Influence Microbial Growth

**Assembly of Life Sciences (U.S.).  
Committee on Nitrite and Alternative  
Curing Agents in Food**

### **Chapter 3 Factors That Influence Microbial Growth:**

**Microbial Contamination and Food Degradation** Alexandru Mihai Grumezescu, Alina Maria Holban, 2017-11-03  
Microbial Contamination and Food Degradation Volume 10 in the Handbook of Food Bioengineering series provides an understanding of the most common microbial agents involved in food contamination and spoilage and highlights the main detection techniques to help pinpoint the cause of contamination. Microorganisms may cause health threatening conditions directly by being ingested together with contaminated food or indirectly by producing harmful toxins and factors that can cause food borne illness. This resource discusses the potential sources of contamination, the latest advances in contamination research and strategies to prevent contamination using key methods of analysis and evaluation. Presents modern alternatives for avoiding microbial spoilage and food degradation using preventative and intervention technologies. Provides key methods for addressing microbial contamination and preventing food borne illness through research and risk assessment analysis. Includes detailed information on bacterial contamination problems in different environmental environments and the methodologies to help solve those problems.

**Progress in Food Preservation** Rajeev Bhat, Abd Karim Alias, Gopinadhan Paliyath, 2012-01-10  
This volume presents a wide range of new approaches aimed at improving the safety and quality of food products and agricultural commodities. Each chapter provides in depth information on new and emerging food preservation techniques including those relating to decontamination, drying and dehydration, packaging innovations and the use of botanicals as natural preservatives for fresh animal and plant products. The 28 chapters contributed by an international team of experienced researchers are presented in five sections covering: Novel decontamination techniques, Novel preservation techniques, Active and atmospheric packaging, Food packaging, Mathematical modelling of food preservation processes, Natural preservatives. This title will be of great interest to food scientists and engineers based in food manufacturing and in research establishments. It will also be useful to advanced students of food science and technology.

**Basic Protocols in Predictive Food Microbiology** Verônica Ortiz Alvarenga, 2023-09-09  
This volume details well established protocols and procedures being used by laboratories and the industry to study Predictive Microbiology in Foods. Chapters guide readers through methods to design and collect data to generate predictive models, the development of a predictive model, approaches to the behavior, mainly and experiments in predictive microbiology. Written in the format of the Methods and Protocols in Food Science series, chapters list necessary materials and methods for readily reproducible protocols. Authoritative and cutting edge Predictive Food Microbiology aims to be a foundation for future studies and to be a source of inspiration for new investigations in the field.

**Food Microbiology** M. R. Adams, M. O. Moss, 2008  
This is the third edition of a widely acclaimed text covering the whole field of modern food microbiology.

**Predictive Microbiology in Foods** Fernando Perez-Rodriguez, Antonio Valero, 2012-12-12  
Predictive microbiology is a recent area within food microbiology which studies the responses of microorganisms in foods to environmental factors e.g. temperature, pH through mathematical functions.

These functions enable scientists to predict the behavior of pathogens and spoilage microorganisms under different combinations of factors. The main goal of predictive models in food science is to assure both food safety and food quality. Predictive models in foods have developed significantly in the last 20 years due to the emergence of powerful computational resources and sophisticated statistical packages. This book presents the concepts, models, most significant advances and future trends in predictive microbiology. It will discuss the history and basic concepts of predictive microbiology. The most frequently used models will be explained and the most significant software and databases e.g. Combase, Sym, Previus will be reviewed. Quantitative Risk Assessment which uses predictive modeling to account for the transmission of foodborne pathogens across the food chain will also be covered.

**Food quality management** Pieter Luning, Willem Marcelis, 2025-07-21. Consumer understanding of food quality is crucial as their concerns for healthy, safe and sustainable food production remain high. This forces actors and stakeholders in the agribusiness and food industry to use quality management as a strategic approach in production and innovation. This book describes Food Quality Management (FQM) in one integrated concept. Firstly, all relevant aspects of food quality management are combined into one FQM function model which shaped the structure of the book chapters. Secondly, the authors have embedded the techno-managerial approach in the book. This approach starts with the notion that food quality is the outcome of the combined effect of food behaviour and human behaviour. The core principle of this approach is the concurrent use of technological and managerial theories and models to analyse food systems behaviour and people's quality behaviour and generate adequate improvements to the system. Topics covered in the book include food quality properties and concepts, essentials of quality management and food technology and details about food and human behaviour. Furthermore, this book describes in detail the technological and managerial principles and practices in the five FQM functions: quality design, quality control, quality improvement, quality assurance and quality policy and strategy. Moreover, for each function a special topic relevant for the function is highlighted, namely consumer-oriented design, product versus resource control, quality gurus and improvement, quality assurance standards and guidelines like GMP, HACCP, ISO2200, IFS and BRC and Total Quality Management. This publication is a must have for students, researchers and agribusiness and food industry professionals active in various areas of food production in the supply chain. The integrated approach with technological and managerial principles and concepts for analysing food quality management issues makes this a valuable reference book.

**Workshop on Basic Microbiology for the Mineral Industry** R. G. L. McCready, V. Sanmugasunderam, W. D. Gould, Canada Centre for Mineral and Energy Technology, 1986. The following workshop has been prepared by the Biotechnology Section of CANMET, the Department of Energy, Mines and Resources for presentation to the members of BIOMINET who wish to gain an understanding of basic microbiology and hopefully an awareness of present and potential applications of biotechnology in the mineral industry. The primary goal of this two-day workshop is to provide a basic understanding of the terminology, cell structure and function, the present and potential

applications as well as the limitations of the biological processes in the mineral industry *The Health Effects of Nitrate, Nitrite, and N-nitroso Compounds* Assembly of Life Sciences (U.S.). Committee on Nitrite and Alternative Curing Agents in Food, 1981 **Alternatives to the Current Use of Nitrite in Foods** Assembly of Life Sciences (U.S.). Committee on Nitrite and Alternative Curing Agents in Food, 1982 Abstract A 2 part study on the health effects of nitrite and related compounds nitrate N nitroso compounds was performed by the US National Research Council Committee on Nitrite and Alternative Curing Agents in Food The purpose of the study was to review the research status and future prospects for developing feasible alternatives to nitrite use as a food preservative The most promising alternative to nitrite use in bacon is the use of alpha tocopherol 500 mg kg in combination with ascorbate 550 mg kg and sodium nitrite 120 mg kg which significantly reduces nitrosamines formation Mutagenicity tests and possible animal toxicity tests should be conducted on this combination The effect of the combination of ascorbate and tocopherol on nitrite's anti botulinal activity in bacon and other cured meat products also should be tested Irradiation with or without nitrite appears to be effective against C botulinum in several cured meat products but further work is needed Other potential nitrite alternatives requiring further evaluation include lactic acid bacteria sodium hypophosphite fumarate esters and potassium sorbate plus low 40 80 mg kg nitrite wz

**Textbook of Diagnostic Microbiology** Connie R. Mahon, George Manuselis, 2000 This 2nd Edition offers students a comprehensive approach to the essential information they need in identifying etiologic agents of infectious diseases New content has been added on emerging viral pathogens newly recognized parasitic agents emerging resistance and emerging technologies Pedagogical features include tables procedures case studies and illustrations Information is presented to beginning level students in a logical approach to microbiology progressing from core principles and concepts to systematic identification of etiologic agents of infectious disease A saleable instructor's CD ROM is also available **Microbiology** Ronald M. Atlas, 1984 Principles of Microbe and Cell Cultivation S. J. Pirt, 1975 *In Vitro Cultivation of Micro-organisms* Open Universiteit (Heerlen, Netherlands), 1992 A biological examination of the underlying themes to consider how pure cultures of micro organisms may be isolated from their primary sources to measure their growth and to examine the parameters which influence their performance in culture Chemical Microbiology Anthony H. Rose, 1965

*The Effect of Modified Atmosphere Packaging on the Physiological and Microbiological Storage Stability of Shredded Cabbage* Michael W. Brown, 1992 Predictive Microbiology Thomas Alexander McMeekin, 1993 Four authors with backgrounds in food microbiology food chemistry mathematics and statistics explain how techniques of predictive microbiology can allow an objective evaluation of the effects of processing distribution and storage on the microbiological safety and quality of foods The trick is to understand the microbial ecology of a process or of a food at a particular point in the chain then use mathematical relationships between microbial growth and the expected environmental conditions to predict the growth or survival of selected organisms Annotation copyright by Book News Inc Portland OR Oral

Microbiology Philip Marsh, Michael V. Martin, 1984      Basic Microbiology with Applications Thomas D. Brock, Katherine M. Brock, 1978 Koch and Cholera Jenner and smallpox Pasteur and Pasteurisation Vaccination Rabies Vaccine Microscopes Nutrition and Microorganisms Blue green Algae Genetics Disease Sterilization Viruses Protozoa Smallpox Measles influenza Hepatitis Polio Fungal diseases Preservation of food Control of plant disease Food from microorganisms Algae Bacteria Fungi Wine Brewing \_\_\_\_\_      **Biochemical Engineering** Frederick Charles Webb, 1964      Effects of Protozoan Predation on Bacterial Clogging of Laboratory Aquifer Microcosms Paul Christopher DeLeo, 1996

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