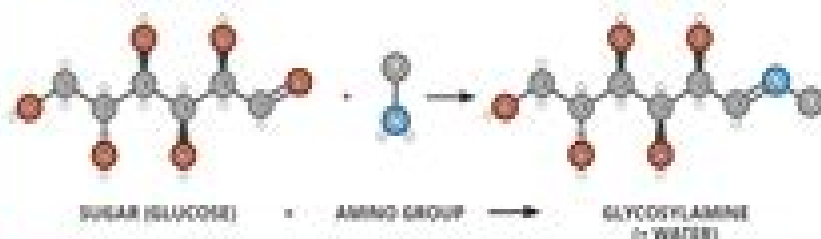


# A GUIDE TO THE MAILLARD REACTION

The Maillard reaction occurs during cooking, and it is responsible for the non-enzymatic browning of foods when cooked. It actually consists of a number of reactions, and can occur at room temperature, but is optimal between 140-165°C. The Maillard reaction occurs in three stages, detailed here.

1

The carbonyl group on a sugar reacts with a protein or amino acid's amino group, producing an N-substituted glycosylamine.



2

The glycosylamine compound generated in the first step isomerises, by undergoing Amadori rearrangement, to give a ketosamine.



3

The ketosamine can react in a number of ways to produce a range of different products, which themselves can react further.



## Classes of Maillard Reaction Products



The Maillard reaction produces hundreds of products; a small subset of these contribute to flavour and aroma, some groups of which are described below. Melanoidins are also formed; brown, polymeric substances which contribute to the colouration of many cooked foods.



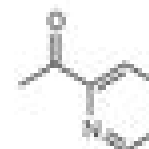
PIRAZINES  
cooked  
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PYRROLES  
cereal-like  
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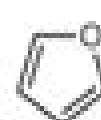
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sweet  
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burnt



FURANS  
meaty  
burnt  
caramel-like



OXAZOLES  
green  
nutty  
sweet



THIOPHENES  
meaty  
roasted

# Maillard Reactions In Foods And Medicine

**Richard Owusu-Apenten**



## **Maillard Reactions In Foods And Medicine:**

The Maillard Reaction in Foods and Medicine J O'Brien, H E Nursten, M J Crabbe, J M Ames, 1998-04-01 This collection of papers are devoted to a single chemical reaction The Maillard reaction They look at various different topics such as its use in the food industry and its relation to ageing and age related diseases **The Maillard Reaction in Foods and Medicine**

John O'Brien, 1998 This collection of papers are devoted to a single chemical reaction the Maillard reaction They look at various different topics such as its use in the food industry and its relation to ageing and age related diseases This collection of papers are devoted to a single chemical reaction the Maillard reaction They look at various different topics such as its use in the food industry and its relation to ageing and age related diseases **Maillard Reaction in Foods** Salvatore

Parisi, Sara M. Ameen, Shana Montalto, Anna Santangelo, 2019-06-01 This book provides an overview of mitigation strategies and positive health effects of Maillard Reaction products in the contexts of food processing and storage The effects of Maillard Reactions can vary considerably while on the one hand certain sensorial alterations and influences on color flavor and odor may be desirable Maillard Reactions can also result in potentially harmful and toxic products e g furfurals furosines or acrylamide This book discusses possible mitigation strategies for the reduction of toxic reaction products including the addition of enzymes or antioxidants reducing sugars and encapsulation approaches as well as new processing strategies such as high pressure radio frequency ultrahigh temperature or Ohmic heating methods The book also illustrates that certain Maillard products can even produce positive health effects e g antimicrobial or anticarcinogenic effects The methods described here can serve as a blueprint for promoting the formation of beneficial compounds and reducing avoiding toxic substances offering essential strategies and methods **Maillard Reaction** Merlin C Thomas, Josephine Forbes, 2010-09-24

In September 2009 a meeting was held in Palm Cove Australia which brought together the world experts in the Maillard or browning reaction This reaction causes the browning of foods when they are heated and in chocolate caramel and beer this reaction is appetizing contributing to aroma taste and texture But when these products accumulate in the body this same process contributes to disease and ageing The book is the proceedings of that meeting held in response to a growing recognition of the role reactive carbonyl compounds play in food technology nutrition and tissue ageing in biology and medicine Reactive carbonyls now touch every aspect of food science biology and medicine Efforts to counteract the damage caused by these products are gaining acceptance as a basis for novel therapeutic approaches and the fields of food technology ageing and preventive medicine are experiencing an upsurge of interest in strategies to minimize the unwanted effects of the Maillard reaction The meeting also fostered a balanced approach to understanding both the advantageous and deleterious properties of carbonyl compounds and their end products in food science technology and medicine The major audience of this book is the large body of scientists and worldwide industries with an interest in the Maillard reaction in foods and biology and medicine with both basic and applied researchers and industry representatives from diverse fields who

have interests in Chemistry of the Maillard Reaction Biology and the Maillard Reaction Enzymology Receptors and Signal Transduction Bioinformatics and Systems Biology Physiology Disease and Therapeutics Food Science and Nutrition and the Maillard Reaction

**Chemical and Functional Properties of Food Saccharides** Piotr Tomasik, 2003-10-20 This fourth volume in the Chemical and Functional Properties of Food Components series focuses on saccharides as food constituents Written by an international group of experts it provides an up to date review of a wide spectrum of issues focusing on the current research and literature on the properties of compounds their mechanisms of action a

**Introduction to Food Chemistry** Richard Owusu-Apenten, 2004-12-16 Providing a thorough introduction to the core areas of food science specified by the Institute of Food Technologists Introduction to Food Chemistry focuses on principles rather than commodities and balances facts with explanations The text covers the major areas of food science including food chemistry food analysis and methods for quality assurance

**Food Carbohydrate Chemistry** Ronald E. Wrolstad, 2012-02-07 Not since Sugar Chemistry by Shallenberger and Birch 1975 has a text clearly presented and applied basic carbohydrate chemistry to the quality attributes and functional properties of foods Now in Food Carbohydrate Chemistry author Wrolstad emphasizes the application of carbohydrate chemistry to understanding the chemistry physical and functional properties of food carbohydrates Structure and nomenclature of sugars and sugar derivatives are covered focusing on those derivatives that exist naturally in foods or are used as food additives Chemical reactions emphasize those that have an impact on food quality and occur under processing and storage conditions Coverage includes how chemical and physical properties of sugars and polysaccharides affect the functional properties of foods taste properties and non enzymic browning reactions the nutritional roles of carbohydrates from a food chemist's perspective basic principles advantages and limitations of selected carbohydrate analytical methods An appendix includes descriptions of proven laboratory exercises and demonstrations Applications are emphasized and anecdotal examples and case studies are presented Laboratory units homework exercises and lecture demonstrations are included in the appendix In addition to a complete list of cited references a listing of key references is included with brief annotations describing their important features Students and professionals alike will benefit from this latest addition to the IFT Press book series In Food Carbohydrate Chemistry upper undergraduate and graduate students will find a clear explanation of how basic principles of carbohydrate chemistry can account for and predict functional properties such as sweetness browning potential and solubility properties Professionals working in product development and technical sales will value Food Carbohydrate Chemistry as a needed resource to help them understand the functionality of carbohydrate ingredients And persons in research and quality assurance will rely upon Food Carbohydrate Chemistry for understanding the principles of carbohydrate analytical methods and the physical and chemical properties of sugars and polysaccharides

**Food Biochemistry and Food Processing** Y. H. Hui, Wai-Kit Nip, Leo M. L. Nollet, Gopinadhan Paliyath, Benjamin K. Simpson, 2008-02-15 The biochemistry of food is the foundation on which the research and development

advances in food biotechnology are built In Food Biochemistry and Food Processing lead editor Y H Hui has assembled over fifty acclaimed academicians and industry professionals to create this indispensable reference and text on food biochemistry and the ever increasing development in the biotechnology of food processing While biochemistry may be covered in a chapter or two in standard reference books on the chemistry enzymes or fermentation of food and may be addressed in greater depth by commodity specific texts e g the biotechnology of meat seafood or cereal books on the general coverage of food biochemistry are not so common Food Biochemistry and Food Processing effectively fills this void Beginning with sections on the essential principles of food biochemistry enzymology and food processing the book then takes the reader on commodity by commodity discussions of biochemistry of raw materials and product processing Later sections address the biochemistry and processing aspects of food fermentation microbiology and food safety As an invaluable reference tool or as a state of the industry text Food Biochemistry and Food Processing fully develops and explains the biochemical aspects of food processing for scientist and student alike

*Handbook of Meat, Poultry and Seafood Quality* Leo M. L. Nollet, Terri Boylston, Feng Chen, Patti C. Coggins, Maria Beatriz Gloria, Grethe Hyldig, Chris R. Kerth, Lisa H. McKee, Y. H. Hui, 2008-02-28 The Handbook of Meat Poultry and Seafood Quality commences with a discussion of basic scientific factors responsible for the quality of fresh frozen and processed muscle foods especially sensory attributes and flavors Following sections discuss factors affecting the quality of beef pork poultry and seafood Under each muscle food some or all of the following factors affecting the quality are discussed additives aroma color contaminants flavors microbiology moisture mouthfeel nutrition packaging safety sensory attributes shelf life stability tainting texture water activity Editor Leo Nollet heads a stellar editorial team and leads an international collection of over 60 expert contributors from government industry and academia in covering the key factors affecting the quality of beef pork poultry and fish and presenting them in a single source

Food Biochemistry and Food Processing Leo M. L. Nollet, Fidel Toldrà, Sottawat Benjakul, Gopinadhan Paliyath, Y. H. Hui, 2012-07-10 Simpson food science and agricultural chemistry McGill U Canada brings together academics and industry professionals working in food biochemistry processing and safety around the world for this 45 chapter textbook aimed at food scientists researchers and technologists in the food industry and faculty and students in food science technology and engineering It combines the areas of food biochemistry and food processing to help them rationalize and develop more effective strategies to produce and preserve food It covers the essential principles of food biochemistry enzymology and food processing then the biochemistry of meat poultry seafoods milk fruits vegetables cereals and fermented foods and food microbiology and safety Along with updates to several chapters this edition has been revised to incorporate safety considerations and the chemical changes induced by processing in the biomolecules of food in each chapter It includes a new section on health and functional foods and 10 new chapters on topics like thermally and minimally processed foods separation technology and allergens

Biochemistry and Molecular Biology Compendium Roger L. Lundblad, 2019-11-11 This book is an accessible resource

offering practical information not found in more database oriented resources The first chapter lists acronyms with definitions and a glossary of terms and subjects used in biochemistry molecular biology biotechnology proteomics genomics and systems biology There follows chapters on chemicals employed in biochemistry and molecular biology complete with properties and structure drawings Researchers will find this book to be a valuable tool that will save them time as well as provide essential links to the roots of their science Key selling features Contains an extensive list of commonly used acronyms with definitions Offers a highly readable glossary for systems and techniques Provides comprehensive information for the validation of biotechnology assays and manufacturing processes Includes a list of Log P values water solubility and molecular weight for selected chemicals Gives a detailed listing of protease inhibitors and cocktails as well as a list of buffers

**Fundamentals and Applications of Fourier Transform Mass Spectrometry** Philippe Schmitt-Kopplin,Basem Kanawati,2019-08-11 Fundamentals and Applications of Fourier Transform Mass Spectrometry is the first book to delve into the underlying principles on the topic and their linkage to industrial applications Drs Schmitt Kopplin and Kanawati have brought together a team of leading experts in their respective fields to present this technique from many different perspectives describing at length the pros and cons of FT ICR and Orbitrap Numerous examples help researchers decide which instruments to use for their particular scientific problem and which data analysis methods should be applied to get the most out of their data Covers FT ICR MS and Orbitrap s fundamentals enhancing researcher knowledge Includes details on ion sources data processing chemical analysis and imaging Provides examples across the wide spectrum of applications including omics environmental chemical pharmaceutical and food analysis

**Flavor Chemistry** Roy Teranishi,Emily L. Wick,Irwin Hornstein,2012-12-06 Celebrating the founding of the Flavor Subdivision of the Agriculture and Food Chemistry Division of the American Chemical Society this book provides an overview of progress made during the past 30 40 years in various aspects of flavor chemistry as seen by internationally renowned scientists in the forefront of their respective fields In addition it presents up to date findings in the areas of flavor chemistry analytical methods thermally produced flavors and precursors enzymatically produced flavors and precursors and sensory methods and results

**Biochemistry of Foods** N.A. Michael Eskin,Fereidoon Shahidi,2012-10-08 This bestselling reference bridges the gap between the introductory and highly specialized books dealing with aspects of food biochemistry for undergraduate and graduate students researchers and professionals in the fields of food science horticulture animal science dairy science and cereal chemistry Now fully revised and updated with contributing authors from around the world the third edition of Biochemistry of Foods once again presents the most current science available The first section addresses the biochemical changes involved in the development of raw foods such as cereals legumes fruits and vegetables milk and eggs Section II reviews the processing of foods such as brewing cheese and yogurt oilseed processing as well as the role of non enzymatic browning Section III on spoilage includes a comprehensive review of enzymatic browning lipid oxidation and milk off flavors The final section covers the new and rapidly expanding area of rDNA

technologies This book provides transitional coverage that moves the reader from concept to application Features new chapters on rDNA technologies legumes eggs oilseed processing and fat modification and lipid oxidation Offers expanded and updated material throughout including valuable illustrations Edited and authored by award winning scientists Chemical Deterioration and Physical Instability of Food and Beverages Leif H Skibsted, Jens Risbo, Mogens L Andersen, 2010-04-23 For a food product to be a success in the marketplace it must be stable throughout its shelf life Quality deterioration due to chemical changes and alterations in condition due to physical instability are not always recognised yet can be just as problematic as microbial spoilage This book provides an authoritative review of key topics in this area Chapters in part one focus on the chemical reactions which can negatively affect food quality such as oxidative rancidity and their measurement Part two reviews quality deterioration associated with physical changes such as moisture loss gain and migration crystallization and emulsion breakdown Contributions in the following section outline the likely effects on different foods and beverages including bakery products fruit and vegetables ready to eat meals and wine With contributions from leaders in their fields Chemical deterioration and physical instability of food and beverages is an essential reference for R D and QA staff in the food industry and researchers with an interest in this subject Examines chemical reactions which can negatively affect food quality and measurement Reviews quality deterioration associated with physical changes such as moisture loss gain and migration and crystallization Documents deterioration in specific food and beverage products including bakery products frozen foods and wine *Flavour Development, Analysis and Perception in Food and Beverages* J K Parker, Stephen Elmore, Lisa Methven, 2014-11-19 Flavour is a critical aspect of food production and processing requiring careful design monitoring and testing in order to create an appealing food product This book looks at flavour generation flavour analysis and sensory perception of food flavour and how these techniques can be used in the food industry to create new and improve existing products Part one covers established and emerging methods of characterising and analysing taste and aroma compounds Part two looks at different factors in the generation of aroma Finally part three focuses on sensory analysis of food flavour Covers the analysis and characterisation of aromas and taste compounds Examines how aromas can be created and predicted Reviews how different flavours are perceived **Food** Tom P. Coulter, 2009 As a source of detailed information on the chemistry of food this book is without equal With a Foreword written by Heston Blumenthal the book investigates food components which are present in large amounts carbohydrates fats proteins minerals and water and also those that occur in smaller amounts colours flavours vitamins and preservatives Food borne toxins allergens pesticide residues and other undesirables are also given detailed consideration Attention is drawn to the nutritional and health significance of food components This classic text has been extensively rewritten for its 5th edition to bring it right up to date and many new topics have been introduced Features include Special Topics section at the end of each chapter for specialist readers and advanced students An exhaustive index and the structural formulae of over 500 food components Comprehensive

listings of recent relevant review articles and recommended books for further reading Frequent references to wider issues e.g the evolutionary significance of lactose intolerance fava bean consumption in relation to malaria and the legislative status of food additives Food The Chemistry of its Components will be of particular interest to students and teachers of food science nutrition and applied chemistry in universities colleges and schools Its accessible style ensures that that anyone with an interest in food issues will find it invaluable Extracts from reviews of previous editions very detailed and readable the author is to be congratulated The British Nutrition Foundation 1985 a superb book to have by your side when you read your daily newspaper New Scientist 1989 mandatory reading for food scientists medical students and anyone else who has an interest in the food we eat The Analyst 1990 filled me with delight curiosity and wonder All of the chemistry is very clear and thorough I heartily recommend it The Chemical Educator 1997 an invaluable source of information on the chemistry of food It is clearly written and I can heartily recommend it Chemistry and Industry 2004 New greatly enlarged or totally revised topics include Acrylamide Resistant starch Pectins Gellan gum Glycaemic Index GI The elimination of trans fatty acids Fractionation of fats and oils Cocoa butter and chocolate The casein micelle Tea flavonoids and health Antioxidant vitamins Soya phytoestrogens Legume toxins Pesticide residues Cow s milk and peanut allergies **Food as a Drug** Walker S C Poston,C Keith Haddock,2014-02-25 Food as a Drug provides psychologists psychiatrists and counselors with a unique discussion about possible addictive qualities of some foods to assist clients who are struggling with obesity or eating disorders Examining the pros and cons of treating eating disorders with an addictions model this book also explores the tremendous societal and personal costs of eating disorders and obesity such as increased risk of heart disease health care costs and death Thorough and concise Food as a Drug will assist you in providing better services to clients with these types of dilemmas Comprehensive and current this reference provides information on relevant topics such as diet and behavior relationships cross cultural perspectives on the use of foods for medicinal purposes regulatory perspectives on drugs foods and nutritional supplements and whether foods have pharmacological properties Food as a Drug address several important topics such as focusing on sugar to determine the effects of food additives on children s behavioral disorders such as attention deficit disorder and hyperactivity addressing the role that your diet plays on serotonin levels carbohydrate craving and depression examining the phenomenological psychological and physiological correlations between overeating and how foods may be used to alleviate negative moods discussing the pros and cons of treating obesity and eating disorders with addiction models Written by experts in the field this book offers you in depth studies and information about the nature of food as a potentially addictive substance Food as a Drug will help you understand these difficult to treat conditions and offer clients better and more effective services Food is your Medicine Dr. Jitendra Arya,2014-03-01 What you plant you priced it s that simple with you and food Our body is our land Before it s too late we need to eat as per our body language and body intelligence Your body speaks Yes it speaks only truth as it remains in the present Your mind may speak lie and stale But not



your body 7 000 000 of the 25 000 000 000 red blood cells in the body of an average man die every second so that 7 000 000 new ones must be produced every second of our lives A wonderful example of the creative operations always at work in our bodies The materials out of which these new cells are built are supplied by food It is to supply material with which to carry on the building up of the tissue and replace that which is broken down In other words to supply material for growth and repair that we eat Last but not the least physically physiologically and biochemically we are human beings herbivorous Our food contains fruits vegetables grains nuts dry fruits pulses oilseeds roots leaves herbs and milk products Let us eat vegetarian diet for health happiness and harmonious life Every cell has got tremendous intelligence and sensitivity Truly what you eat you become Then eat healthy happy and consciously Let s eat conscious diet and get connected with consciousness the whole Lets truly become one within and with oneness

**Handbook of Pediatric Nutrition** Patricia Queen Samour, Kathy King (RD.), 2005 Handbook of Pediatric Nutrition Third Edition provides cutting edge research and resources on the most important pediatric issues and therapies such as prenatal nutrition weight management vegetarian diets diabetes guidelines and transplant nutrition concerns Commonly used by dietetic practitioners studying for their Pediatric Specialty exams registered dietitians dietetic technicians nutritionists pediatricians nurses and dietetic students this book is considered the last word in pediatric nutrition

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