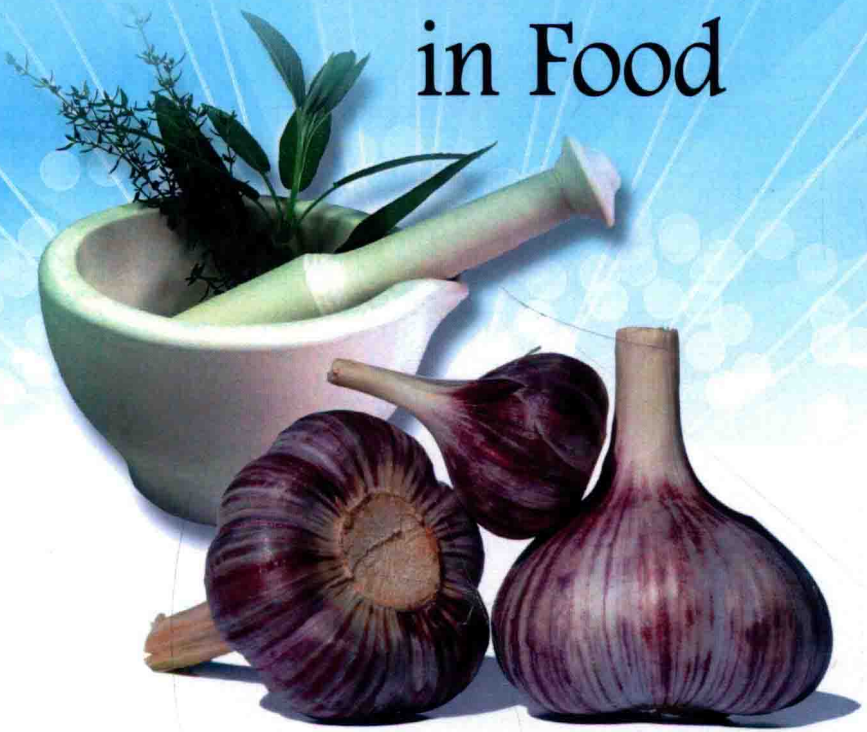
Applications of Natural Products in Food



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APPLICATIONS OF NATURAL PRODUCTS IN FOOD

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PREFACE

This book is focused on new researches pertaining to the following areas: herbs and spices commonly-used in foods, bioactive compounds derived from plants with specific focus on applications of natural products as antibacterial agents and antioxidants in foods. The data recorded through ethnopharmacological field studies are invaluable as these provide information on medicinal plants used to treat foodborne diseases. Pharmacognostic studies on certain plants have been included which provides basic data to help fixing-up their pharmacopoeial standards, thereby ensuring quality food additives. Other interesting topics include reviews on proposed mechanisms of actions of natural products as well as applications in the food industry.

CONTENTS

Chapter 1

INTRODUCTION

A variety of microorganisms may cause food spoilage or food poisoning which is major concerns for food industries. Use of chemicals to enhance food safety has been of great interest. Chemical preservatives vary in their effectiveness in eliminating microorganisms depending on the types as well as physical and chemical characteristics of foods (Cherry, 1999). Most commonly-used chemical preservatives include weak acids or their salts or esters such as lactic acid, citric acid, acetic acid, sodium benzoate, potassium sorbate, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and tertiary-butyl hydroquinone (TBHQ). However, consumers have grown serious awareness on health risks associated with the use of these chemicals. Concerns over the safety of some chemical preservatives and negative consumers' reaction to these preservatives they perceive as chemical and artificial, have prompted an increased interest in natural alternatives. Moreover, the use of chemical-based antimicrobials in the treatment of many infectious diseases had inevitably resulted in multiple-drug or chemical resistance in both animal and plant pathogens (Davis, 1994).

Although the antimicrobial properties of herbs and spices have been long recognized, recent researches in naturally-derived antimicrobials have led to a renewed scientific interest in these substances. A possible alternative to synthetic antimicrobials is the use of plants and their products, together with the essential oils which are thought to be generally effective for food safety and preservation (Lanciotti et al., 2004). Western society appears to be experiencing a trend of 'green' consumerism (Smid and Gorris, 1999), desiring fewer synthetic food additives and products with a less impact on the environment. Furthermore, the use of natural preservatives to improve the shelf life of meat products is a promising technology as many herbs, spices,

and their essential oils have demonstrated both antioxidant (Rey et al., 2005; Bañón et al., 2007; Carpenter et al., 2007; Jayathilakan et al., 2007; Juntachote et al., 2007; Ifesan et al., 2009d) and antimicrobial properties (Ahn et al., 2004; Gutierrez et al., 2008; Solomakos et al., 2008; Ifesan et al., 2009d).

It is estimated that there are 250,000 to 500,000 species of plants on Earth (Borris, 1996), while about 1 to 10% of these have been used as foods by humans and other animal species. Plants have an almost limitless ability to synthesize aromatic substances, most of which are phenols or their oxygen-substituted derivatives (Geissman, 1963). Populations consuming diets rich in fruits and vegetables have shown to have lower incidences of many oxidation-linked chronic diseases such as cancer, cardiovascular diseases, and diabetes. This has led to a recent surge in interest in the use of diet as a potential tool to manage oxidation-linked diseases. Phenolic phytochemicals with antioxidant properties are now believed to be an important component in fruits and vegetables responsible for these beneficial health effects (Vattem, 2004). The substances serve as plant defense mechanisms against predation by microorganisms, insects, and herbivores. These include compounds such as terpenoids, which give plants their odours, quinones and tannins which are responsible for plant pigments. More importantly, a wide range of herbs and spices used by humans to season food yield useful medicinal compounds.

'Herb' is a plant grown for medicinal value or for flavouring food. On the other hand, Food and Drug Administration (FDA) stated a definition for 'spice' as an aromatic vegetable substance in the whole, broken, or ground form, the significant function of which in food is seasoning rather than nutrition and from which no portion of any volatile oil or other flavouring principle has been removed (FDA, 1980). Some plants are considered to be both herb and spice as there are no clear distinctions between them in most of the scientific literatures. Many spices are herbal products and their essential oils extracts have been reported. The essential oils and terpenoid alcohols of spices contribute to their taste and tactile sensation. Menthol, from mint, has a cooling effect as well as characteristic fresh taste (Shelef, 1983; Aktug and Karapinar, 1986; Arora and Kaur, 1999; Delgado et al., 2004; Nassar-Abbas and Hakman, 2004). Cardamom, cloves, oregano, and some other spices and herbs contain eugenol of which is fragrant and aromatic. Ginger contains gingerols, zingiberene, and other characteristic agents that make it an important flavour in Asiatic and Arabic herbal traditions (Kovacs et al., 2004). Naturally-sourced substances are becoming more widely used in the food industry both as flavouring and tenderizing agents (Sinku et al., 2003; Rajkovic et al., 2005; Rey et al., 2005; Garg and Mendiratta, 2006;

Jayathilakan et al., 2007; Naveena et al., 2008; Ifesan et al., 2009c, 2009d). In addition, antimicrobial properties of a number of medicinal plants have been extensively reported (Murakami et al., 1994; Murakami et al., 1995; Voravuthikunchai et al., 2002; Alzoreky and Nakahara, 2003; Voravuthikunchai and Kitpipit, 2003; Voravuthikunchai et al., 2004a, 2004b, 2004c; Siripongvutikorn *et al.*, 2005; Voravuthikunchai and Kitpipit, 2005; Voravuthikunchai et al., 2005a, 2005b, 2005c; Oonmetta-aree et al., 2006; Valero and Frances, 2006; Voravuthikunchai and Limsuwan, 2006; Voravuthikunchai et al., 2006a, 2006b, 2006c, 2006d, 2006e; Voravuthikunchai, 2007; Voravuthikunchai et al., 2007; Limsuwan and Voravuthikunchai, 2008; Saising et al., 2008; Voravuthikunchai and Mitchell, 2008; Voravuthikunchai and Suwalak, 2008; Voravuthikunchai et al., 2008a, 2008b, Del Nobile et al., 2009; Ifesan and Voravuthikunchai, 2009; Ifesan et al., 2009a, 2009b, 2009c, 2009d, 2009e; Limsuwan and Voravuthikunchai, 2009; Voravuthikunchai and Suwalak, 2009; Voravuthikunchai et al., 2009). However, selection of a natural antimicrobial should be based on the sensory and chemical compatibility of the antimicrobial with the food, its stability considering the type of primary preservative system used, and the safety of the consumers.

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