Noninvasive Quantification of Lipid and Water in Food Using Magnetic Resonance Imaging

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B.S. (University of Nebraska, Lincoln) 1986

THESIS

Submitted in partial satisfaction of the requirements for the degree of

MASTER OF SCIENCE

in

Food Science

in the

GRADUATE DIVISION

of the

UNIVERSITY OF CALIFORNIA
DAVIS

Approved:

Committee in Charge

1989

Chapter One: Stereochemical Specificity of the n-9 Lipoxygenase of Fish Gill

Content of this chapter form the basis for a manuscript to be published.

Abstract

Stereospecificity of oxygen addition distinguishes lipoxygenase initiated lipid peroxidation from non-enzymatic autoxidation which produces a racemic mixture. Similarly, the positional and stereoconfiguration of lipoxygenase metabolites of unsaturated fatty acids determines their precise physiological bioactivity. Fish gills produce large quantities of 12 hydroxy eicosatetraenoic acid. This investigation determined the exact structure of the molecule. Following reaction of fish lipoxygenase with arachidonic acid, 12-hydroxyeicosatetraenoic acid (12-HETE) was isolated using HPLC. Chiral phase HPLC identified chirality of 12-HETE based on 12(S)-HETE and 12(R)-HETE standards. A proton NMR spectrum identified the overall structure of the product as 12(S)HETE. Characterization of stereochemistry of products is a useful tool to study initiation reactions of lipid oxidation in food.

Chapter Two: Noninvasive Quantification of Lipid and Water in Food Using Magnetic Resonance Imaging

Contents of this chapter form the basis for a manuscript to be submitted for publishing.

Abstract

The structural properties and quality of many foods depend upon changes in the state and distribution of food components. However, information on the distribution of food components and their role in the providing structure has been difficult to investigate in actual foods. Noninvasive, dynamic measurement of these foods can now be made with nuclear magnetic resonance imaging to simultaneously investigate both lipid and water separately. A magnetic resonance imaging spectrometer was used to measure the hydrogen signal of an oil-water model system. Different relaxation values exhibited by each component allowed resolution of oil and water separately through relaxation weighted images. This approach is applicable to the study of food structure, dynamics, and component interactions.

Chapter Three: Characterization of Muscle Foods Using Magnetic Resonance Imaging

Contents of this chapter form the basis of a manuscript to be submitted for publishing

Abstract

Water and lipid components in meat contribute to the overall texture and quality of the muscle tissue as food. Spatial distribution of the water and fat components in red meat, fish, and chicken was determined using magnetic resonance imaging techniques. Hydrogen signal contributed by water is differentiated from the hydrogen signal of lipids using relaxation weighted spin-warp spin echo pulse sequences, which allow fat enhanced and water enhanced magnetic resonance images to be generated. Average spin-lattice and spin-spin relaxation times for fresh and previously frozen fish were not significantly different.

information on the physical state of the oil and water components, noninvasively.

Acknowledgements

This work was supported in part by a grant from California Sea Grant and the UC-Davis NMR Facility.

(German; R/F-133)