BIOLOGICAL AND PHYSIOLOGICAL STUDIES ON CERTAIN IRRADIATED MICROORGANISMS

BY

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THESIS

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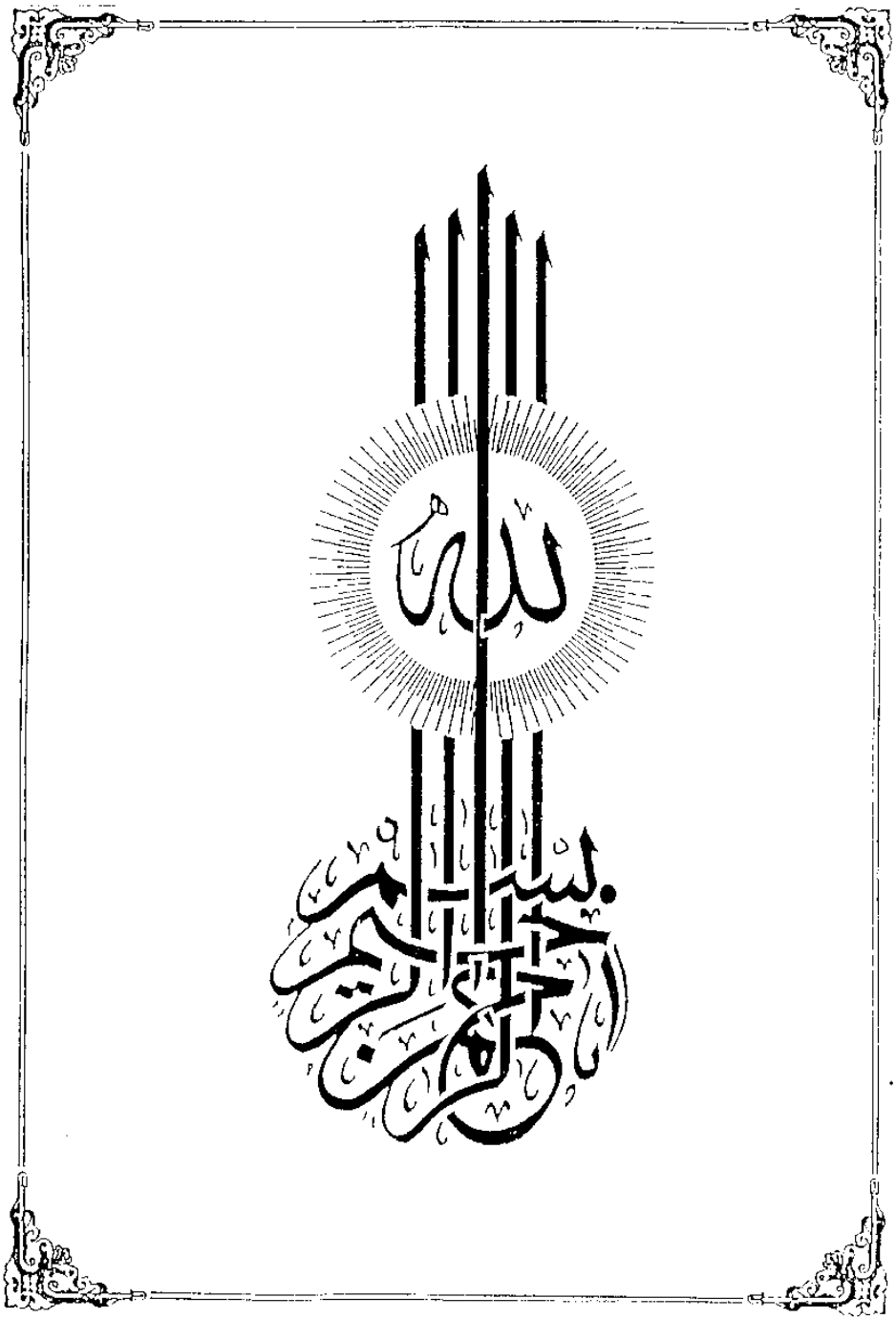

NOTE

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General preface

The use of ionizing radiation for the preservation of food and food products is now an established technology which is steadily replacing other preservation techniques on the grounds of convenience, economy and freedom from cross - contamination.

Preservation of food can be accomplished by chemical, biological, or physical means. Physical methods of preservation are used extensively in developed countries of the world and they are likely to become more common world wide (Karel, et. al., 1975).Physical approaches to preserving food include temporary increase in the product's energy level (heating, irradiation), reduction of the product's temperature, reduction in the product's, water content and the use of protective packages. Rarely is a single method effective and usually several are combined (Frazier & Westhoff, 1978).

The present investigation aimed at the examination of preserving fish, fish - fillet and shrimp by three physical methods namely ionizing radiation, temperature and reduction of the water activity. Each of these methods of fish preservation was examined separately as well as in combination with each other. The aspects investigated limit the scope of the thesis to the following topics.

1. Lethality and injury of the microbial flora of ground fish by each of : radiation, temperature (high or low), and reduction of water activity.

2. Inactivation and injury of the " most radioresistant " bacteria isolated from ground fish by the effect of each of the above mentioned physical factors.

3. Effect of the combined treatment Viz, irradiation and temperature (high or low), or irradiation and reduced water activity on the viability and injury of the most radio - resistant bacteria isolated from ground fish.

4. Effect of different reduced water activity (separately and in combination with thermal treatment) on the injury and sensitivity of bacteria isolated from ground fish.

INTRODUCTION

Introduction

Most kinds of food are readily decomposed by microorganisms unless special methods are used for their preservation.

Food deterioration usually occurs when spoilage microorganisms use the food supply as a source of nutrients for their own growth, (Frazier & Westhoff, 1978).

Deterioration of seafood is mainly due to the effect of enzymes from either their own tissues or from contaminating microorganisms resulting in the consequent formation of compounds leading to offodours, colours and flavours, (Frazier & Westhoff 1967). The chief methods of food preservation are, either chemical, biological or physical methods.

Food preservation by chemical methods involve the addition of substances such as sugars, salts, or acids to the food, or the exposure to chemicals such as smoke or fumigants.

Biological preservation involves alcoholic or acidic fermentation.

Physical approaches to preserving food include a temporary increase in the product's energy level through heat or radiation exposure or controlled reduction of the product's temperature by chilling or, freezing or controlled reduction in the products water content (through concentration, air delydration, freezing and drying), and the use of protective packages (Karel et. al.,1975).

The above mentioned conventional chemical or physical methods of food preservation (except for radiation) have

however, obvious limitations in view of the steadily rising public opinion against food additives, the loss of flavour and freshness associated with canning, the expensive equipment needed for refrigeration and freezing. For these reasons, the use of ionizing radiation offers a new approach to solve this problem.

One of the principal values of ionizing radiation in food preservation arises from its ability to destroy, (without the application of heat), the microorganisms which cause food spoilage and deterioration. In 1980, International Atomic Energy Agency recommended that any food could be irradiated up to a dose of 10 KGy and hence such foods no longer need to be tested for toxicity.

The present study is concerned with investigations of three of the physical approaches used in food preservation namely radiation, temperature and water activity. Therefore, in the present review attempts are made to give an account of the microbial inactivation by ionizing radiation, by thermal treatment, or by the control of the water activity. Each of these factors is applied separetly or in combination.

Accordingly this review deals with the following topics :

1. Food preservation by irradiation.
2. Preservation of food by temperature (high or low).
3. Injury of bacterial cells and spores as a result of exposure to high or low temperature.
4. Food preservation by combination treatment.

1. <u>Food preservation by irradiation</u> :

The ability of radiation to kill microorganisms has been the object of investigation since the late 19 <u>th</u> century.

Research directed toward the use of radiation for the preservation of food began in 1945 (Karel et. al.,1975). On the basis of preliminary data the wholesomeness of irradiated food is likely to be established and comomercial preservation of food by ionizing radiation is likely to follow. It is thus important to recognize the different types of ionizing radiation.

Radiation is defined as physical phenomena in which energy travels through space, without the aid of a material medium.

Ionizing radiation includes a variety of highly energetic radiation having in common the ability to eject electrons from atoms in the matter through which they pass. This leads to the production of positively and negatively charged ions, hence the name ionizing radiation (Lawerence, 1971). Therefore ionizing radiation is any radiation consisting of directly or indirectly of ionizing particles or a mixture of both. The major types of directly ionizing particles are electrons, protons and alpha particles, which transfer their kinetic energy and produce ionization by collision. The indirectly ionizing particles are for example, uncharged photons of X-rays, gamma rays or neutrons. They are able to liberate ionizing electrons directly as X and gamma rays or can initiate a nuclear transformation as neutrons (IAEA, 1968).

The proccessing of food with ionizing radiation (radaprocess) results in a reduction in the number of viable bacteria with a consequent increase in its storage life without refrigeration. The Rada-process is divided according to the dose level into three main groups : radappertization, radurization and radicidation (Goresline et. al., 1964). Radappertization, is the application to food of doses of ionizing radiation sufficient to reduce the number and / or activity of viable organisms to such an extent that very few, if any are detectable in