THE UNIVERSITY OF MANITOBA

FLAVOR INTERACTION OF SOY PROTEIN AND TOMATO SAUCE

by

NORA CHAN

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF FOODS AND NUTRITION

WINNIPEG, MANITOBA

JUNE, 1979

FLAVOR INTERACTION OF SOY PROTEIN AND TOMATO SAUCE

BY

LAI-YUE NORA CHAN

A dissertation submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF SCIENCE

ACKNOWLEDGEMENTS

The author wishes to express sincere thanks to her advisor, Dr. Mina McDaniel, of the Department of Foods and Nutrition, University of Manitoba, for her guidance throughout the entire project.

Appreciation is also extended to Dr. Ernest Hoehn, Department of Food Science, for his advice on the project, Dr. M. Samanta, Department of Statistics, for statistical consultation and Dr. Bruce Johnston, Department of Statistics, for assistance in computational work.

The author would like to extend special thanks to Ms. Karen Donaldson Erin, Ms. Janet Fabro, Ms. Marilyn Latta, Ms. Ruth Loewen, Ms. Linda Malcolmson and Dr. Mina McDaniel who faithfully attended taste panel sessions and contributed valuable ideas and opinions to the study.

ABSTRACT

Flavor interaction in a model system of soy/tomato mixtures was studied. The system consisted of a constant level of soy protein (5% w/w) in various concentrations of tomato sauces (55 - 100%). Since textural differences resulting from varying tomato concentrations might interfere with taste judgment, two series of tomato sauces of identical concentration were made up. Varying quantities of a thickener were added to one of the series, so that all the sauces were of equivalent viscosity.

A six-member trained panel defined the dominant odors of soy protein as whole grain-like, raw green beany, sweet and cooked cold potato-like; and its tastes as whole grain-like, beany, sweet and bitter. The odors of tomato sauce were described as fruit-like, heavy/earthy, acidic, metallic and canned tomato-like; while its tastes were described as acidic, harsh, bitter, astringent and canned tomato-like.

Perceived intensities of the tastes of tomato sauces as a function of tomato concentration were determined. The taste characteristics evaluated were overall taste, acidic, harsh, bitter and astringent. The intensities of the different tastes were found to increase with tomato concentration.

Combination of the soy and tomato components resulted in the repression of certain tomato flavors: harsh, bitter

and astringent. The presence of soy protein significantly reduced the intensities of the overall and acidic tastes of the tomato sauces. Reduction appeared to be greater at the lower concentration region. The slopes of the intensity functions were not significantly affected. Similarly, the individual odors and tastes of the soy protein became indistinguishable in the soy/tomato mixtures. The overall soy odor, taste and aftertaste were substantially reduced in intensities with the increase in tomato concentration in the mixtures. Pleasantness of the mixtures increased linearly with the increase in tomato concentration at a rate approximating those of the overall and acidic tastes of the tomato component in the mixtures. The addition of a thickener generally did not affect the intensities of the different tastes or the pleasantness of the mixtures.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Page

LIST OF APPENDICES

INTRODUCTION

The importance of soy protein has emerged with the increasing demand for new protein sources. The U.S. alone produced 42 million metric tons of soybeans in 1975 and the figure was expected to reach 61 million metric tons by 1985.

Soy protein offers an economical and nutritional alternative to the conventional meat protein. It has been estimated that an annual 500 pounds of soy protein could be produced from the same acre of land which could only raise 58 pounds of beef protein. With heat treatment and proper processing, the nutritive value of soy protein could be improved to approach that of meat and milk.

In spite of the great potential for food use, the application of soy protein in human foods is still limited. The greatest deterrent was found in the unpleasant flavors, especially beaniness and bitterness, associated with the product. Many attempts have been made to ameliorate this problem. Most of the methods aim at removing the off-flavor components or preventing their formation. However, recent studies indicate that these endeavours have not been entirely successful. Unpleasant flavors still exist in various commercial soy protein products (Kalbrener et al., 1971) and the addition of certain brands of textured soy protein to beef patties has been demonstrated to greatly detract from flavor desirability ratings (Smith et al., 1976).

A practical alternative appears to be masking the off-flavor of soy protein with a food system that possesses flavors that are both pleasant and strong. The tomato seems to be a suitable food to serve this purpose. It has a strong flavor and is well liked by most people in North America. Tomato juice has demonstrated a superior masking ability for bitterness when compared to another food (Mackey and Valassi, 1956). The major amino acids in tomatoes are glutamic and aspartic acids which have been found useful for masking bitterness (Watanabe, 1974). A glutamic acid rich oligopeptide also displays potent bitter-masking activity (Noguchi et al., 1975). As well, the most common use of soy protein lies in the extension of communited meat products such as ground meat patties, meat sauce and sausages where the use of tomato sauce is customary. It was decided, therefore, to observe the masking effect of tomato flavors on the flavors of soy protein.

The major objectives of the present study are as follows:

1. To develop a model system in which to test the interaction between soy and tomato flavors.

    a. To determine the sensory attributes of the model system — flavor characteristics and intensities of the soy and tomato components.

    b. To test the effect of cornstarch, used as a thickening agent, on the sensory attributes of the model system.

2. To determine qualitatively and quantitatively the soy/tomato flavor interaction in the presence and absence of the thickening agent.

3. To observe the pleasantness of the soy/tomato mixtures.

REVIEW OF LITERATURE

A. Flavor of Soy Protein Products

Much effort has been expended to achieve a bland soy protein product. However, experimental evidence consistently confirmed the presence of undesirable flavors in soy protein, the most predominant ones being beaniness and bitterness. Slight variations in flavor had been observed in various product forms due to the different kinds of processing applied.

Moser et al. (1967) evaluated the effect of steaming on the flavors of full fat soy flour. A 16-member trained panel was selected to evaluate a 25% aqueous soy flour slurry on a 10-point scale (1 = strong; 10 = bland). The raw full fat soy flour which served as the control was rated a low 1.5 with flavors described as beany, bitter and green in order of their prominence (Table 1). The flavor was significantly improved to a score of 6.3 with steaming up to a duration of 20 minutes. The green flavor disappeared, bitterness was reduced while new flavors: nutty, toasted, sweet emerged. Honig et al. (1969) described raw defatted soybean meal as possessing green, beany, bitter flavors, with a throat-catching, lingering aftertaste. However, the conditions of the tasting procedures were not detailed. Kalbrener et al. (1971) substantiated the above findings in their study of the odors and tastes of various commercial de-

TABLE 1

EFFECT OF STEAMING ON THE FLAVOR OF SOY FLOUR

Steaming duration (min.)	Flavor score[a]	Flavor description
0	1.5	beany, bitter, green
3	4.5	beany, bitter, nutty, sweet, toasted
10	6.0	beany, nutty, bitter, toasted, sweet
20	6.3	beany, nutty, bitter, toasted, sweet
40	6.1	beany, nutty, bitter, toasted, sweet

[a] 1 = strong; 10 = bland.

(from Moser *et al.*, 1967)

fatted soybean flavors, concentrates and isolates. Samples were presented to a 17-member panel as 2% dispersion in water. The panelists rated the odor and taste intensities of each sample on a 10-point scale (1 = strong; 10 = bland) and described the predominant odors and tastes present. Table 2 contains the intensity scores of the samples with a list of their odor and taste descriptors. Apparently, the additional processing procedures necessary to produce concentrates and isolates did not substantially affect the odor and taste intensities of soy protein, as all the three types of products achieved a similar maximum score. The effect of processing, however, was reflected in the descriptions. While some odor descriptors such as beany, cornmeal, CW (a combination of cereal and singed wool in water) were common to all, each type of product possessed a slightly different odor profile from the others. The predominant tastes in all the products were beaniness and bitterness. However, differences again appeared in the description of each type. The green beany taste was peculiar only to the soy flour. Astringency was noted only in the concentrates and isolates. The isolates received the most varied responses including cardboard, chalky, mealy, toasted, flour and nutty.

The range of odor and taste intensity scores within individual product type reflected the variability in quality among the commercial products. The flour samples exhibited the widest score range and the isolates the least. The considerable improvement in the scores of some flour samples was