EFFECT OF ULTRASONICATION ON YIELD, TEXTURE, AND NUTRITIONAL CONTENT OF TOFU MADE FROM GREEN PEAS (*Pisum sativum*)

AMMARA GHANIYA ADI

DEPARTEMENT OF FOOD SCIENCE AND TECHNOLOGY
FACULTY OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
IPB UNIVERSITY
BOGOR
2025

STATEMENT REGARDING THE THESIS, SOURCES OF INFORMATION AND ASSIGNMENT OF COPYRIGHTS

I hereby declare that the proposal entitled "Effect of Ultrasonication on the Texture and Nutritional Content of Tofu Made from Green Peas (*Pisum sativum*)" is my work under the direction of my supervisor and has not been submitted in any form to any university. Sources of information originating or quoted from published or unpublished works from other authors have been mentioned in the text and listed in the Bibliography at the end of this thesis.

I hereby delegate the copyright of my paper to IPB University

Bogor, October 2025

Ammara Ghaniya Adi
F2401211805

ABSTRAK

AMMARA GHANIYA ADI. Pengaruh Ultrasonikasi terhadap Rendemen, Tekstur, dan Kandungan Gizi Tahu dari Kacang Polong Hijau (*Pisum sativum*). Dibimbing oleh EKO HARI PURNOMO and RAHAYU LESTARI SUGIARTINI

Kedelai (*Glycine max (L.) Merr*.) merupakan bahan baku utama dalam produksi tahu, namun ketergantungan Indonesia yang tinggi terhadap kedelai impor menimbulkan kekhawatiran terkait keberlanjutan dan ketahanan pangan. Kacang polong hijau (*Pisum sativum*) yang tersedia secara lokal namun masih kurang dimanfaatkan menawarkan potensi sebagai sumber protein alternatif. Penelitian ini bertujuan untuk mengoptimalkan perlakuan ultrasonikasi berbasis energi pada bubur kacang polong hijau guna meningkatkan kualitas tahu, terutama dalam hal rendemen, tekstur, dan komposisi gizi. Ultrasonikasi diterapkan menggunakan kombinasi amplitudo (30%, 60%, dan 90%) dan waktu perlakuan (5, 10, dan 15 menit) sebelum proses koagulasi menggunakan magnesium klorida ($MgCl_2$). Kedua parameter tersebut digabungkan menjadi satu variabel fundamental, yaitu energi ultrasonikasi (kJ). Analisis berbasis energi ini memungkinkan semua perlakuan dipetakan dalam satu kerangka energi total untuk mengidentifikasi kondisi optimum proses. Hasil penelitian menunjukkan bahwa energi ultrasonikasi secara signifikan memodifikasi matriks protein yang tercermin dalam hubungan parabola terbalik antara energi dengan rendemen, atribut tekstur dan sebagian besar komposisi gizi. Perlakuan optimum dicapai pada energi sekitar 162 kJ yang menghasilkan tahu dengan rendemen tertinggi mencapai 78.38% kenaikannya dibandingkan tanpa treatment ultrasonikasi. Ini menunjukkan bahwa tahu dari kacang polong hijau yang diproses pada kondisi energi optimum terbukti berpotensi menjadi bahan baku alternatif yang menjanjikan untuk produksi tahu berprotein tinggi di Indonesia.

Kata kunci: Kacang Polong, Profil Tekstur, Rendemen, Tahu, Ultrasonikasi

ABSTRACT

AMMARA GHANIYA ADI. Effect of Ultrasonication on the Yield, Texture and Nutritional Content of Tofu Made from Green Peas (*Pisum sativum*). Supervised by EKO HARI PURNOMO and RAHAYU LESTARI SUGIARTINI.

Soybeans (*Glycine max (L.) Merr.*) are the primary raw material in tofu production; however, Indonesia's heavy dependence on imported soybeans raises concerns about sustainability and food security. Green peas (*Pisum sativum*), which are locally available but underutilized, offer potential as an alternative protein source. This research aimed to optimize an energy-based ultrasonication treatment of green pea slurry to enhance tofu quality, particularly in terms of yield, texture, and nutritional composition. Ultrasonication was applied using combinations of amplitude levels (30%, 60%, and 90%) and treatment times (5, 10, and 15 minutes) prior to coagulation with magnesium chloride ($MgCl_2$). These two parameters were combined into a single fundamental variable, ultrasonication energy (kJ). This energy-based analysis allowed all treatments to be mapped within a unified total-energy framework to identify the optimum processing condition. The results revealed that ultrasonication energy significantly modified the protein matrix, as reflected by the inverted parabolic relationship between energy and yield, texture attributes, and most nutritional parameters. The optimum condition was achieved at approximately 162 kJ, which produced tofu with the highest yield representing a 78.38% increase compared with the non-sonicated control. These findings demonstrate that green pea-based tofu processed under optimum ultrasonication energy conditions shows strong potential as a promising alternative raw material for high-protein tofu production in Indonesia.

Keywords: Green peas, Texture Profile, Tofu, Ultrasonication, Yield

EFFECT OF ULTRASONICATION ON TEXTURE AND NUTRITIONAL CONTENT OF TOFU MADE FROM GREEN PEA (*Pisum Sativum*)

AMMARA GHANIYA ADI

Undergraduate Thesis
Submitted as a requirement for obtaining
Bachelor's Degree in Food Technology

DEPARTEMENT OF FOOD SCIENCE AND TECHNOLOGY
FACULTY OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
IPB UNIVERSITY
BOGOR
2025

Examiner Team on the Undergraduate Thesis Examination:
Dr.Ing. Dase Hunaefi, S.T.P., M.Food.St.

Thesis Title : Effect of Ultrasonication on Yield, Texture, and Nutritional Content of Tofu Made from Green Peas (*Pisum sativum*)
Name : Ammara Ghaniya Adi
Studemt ID : F2401211805

Approved by

Supervisor 1:
Prof. Dr. Eko Hari Purnomo S.T.P., M.Sc

Supervisor 2:
Rahayu Lestari Sugiartini S.Si., M.T

Acknowledged by

Head of Department:
Prof. Dr. Eko Hari Purnomo S.T.P., M.Sc
NIP 19760412 199903 1 004

Date of Examination:
24th October 2025

Date of Passed:

PREFACE

First and foremost, I would like to express my utmost gratitude to Allah SWT for His blessings, guidance, and strength that have accompanied me throughout this journey and enabled me to complete my research. I am sincerely thankful to my first supervisor, Prof. Dr. Eko Hari Purnomo, S.T.P., M.Sc, and my second supervisor, Rahayu Lestari Sugihartini, S.Si., M.T, for their invaluable guidance, encouragement, and continuous support, without which this research would not have been possible.

1. My heartfelt appreciation also goes to Nomura Nakao-sensei, who kindly accompanied me during my exchange year at the University of Tsukuba, Japan. I am also grateful to PPI Ibaraki, the AIMS 2024 family (Crisha, Gianne, Mizah, Pauline, Sara, Rabbiya, Rawan, Zhanna, and all my Egyptian friends), and especially my fellow AIMS Indonesian friends (Alya, Andhika, Azzahra, Emir, Jovan, Naya, Philip, Walada, and Yume), whose warmth and companionship made Japan far less lonely and filled my exchange with unforgettable memories.
2. I would also like to extend my gratitude to my dear friends from Foodturistic58 and K4mugadiajak (Angel, Ameera, Azzahra, Belva, Bintang, Kharis, Nayla, and Ruth), who stood by me both as friends and as project-based learning teammates. Thank you for sharing all the challenges of lab work and making the research process more meaningful and enjoyable.
3. To FATETA58, I am deeply grateful for being a place where I could grow and be involved in various committees such as BEM FATETA, FCD, FAC, and Skill Corner. Special thanks to Shakira, who entrusted me to represent OMI, giving me the opportunity to develop skills I never knew I had and create so many wonderful memories along the way.
4. I also wish to express my appreciation to my KKN Kedamaian team in Lampung (Adi, Agung, Anastasya, Dezet, Kyla, Olan, and Widi). Thank you for the collaboration, care, and meaningful experiences we shared together, as well as the unforgettable memories with the local community of Kedamaian.

Last but certainly not least, I am profoundly grateful to my family. To my father, Moh. Adib, and my mother, Ratih Agustifa Retnandari, thank you for raising me with the freedom to explore the world and for always giving me the courage to chase opportunities as if you were giving me the whole world. To my dearest sister, Nadira Iswarini Hapsari Adi, thank you for being a constant listener to my worries and prayers, and for being the person I could always rely on for comfort and strength. To my beloved brother, M. Ragari Paramanandana Adi, thank you for creating Ayoola Coffee and Matcha shop, which became the most comfortable space for me to work on my thesis over countless cups of usucha and americano. I know I could never have asked for anything more.

Bogor, October 2025

Ammara Ghaniya Adi

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURE

LIST OF APPENDIX