



UNDERGRADUATE THESIS

OPTIMIZATION OF DAILY FOOD COMBINATIONS FOR DIABETICS USING THE ARTIFICIAL IMMUNE SYSTEM ALGORITHM METHOD

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INFORMATICS STUDY PROGRAM
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2026**

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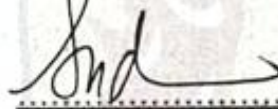
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Hereby declares that this undergraduate thesis contains no part of any other scientific work that has been submitted to obtain an academic degree at any higher education institution. Furthermore, it does not contain any work or opinions previously written or published by others, except for those which are explicitly cited in this thesis and listed completely in references.

And I declare that this scientific document is free from elements of plagiarism. If in the future indications of plagiarism are found in this Thesis, I am willing to accept sanctions in accordance with the applicable laws and regulations.

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Declarant,



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ABSTRACT

Student Name / NPM : Fajar Chandra Aditiya / 20081010090
Thesis Title : Optimization of Daily Combinations for Diabetics
Using Artificial Immune System Algorithm
Supervisor : 1. Dr. Rizky Parlika, S.Kom, M.Kom
2. Andreas Nugroho Sihananto, S.Kom., M.Kom.

Food waste at the household level remains a critical issue, largely driven by the failure to utilize ingredients before they expire. This study develops an image-based recipe recommendation system that leverages the Artificial Immune System Algorithm (AISA) to detect ingredients nearing their expiration date. Inspired by the biological immune mechanism, AISA employs clonal selection and somatic hypermutation processes to classify visual features of 12 common food ingredient categories including eggs, chicken, tempeh, tofu, broccoli, carrots, and others stored in a refrigerator. A dataset of 6,000 images was collected from public sources and expanded through augmentation, with each image represented as a 512-dimensional feature vector combining HSV color histograms and Local Binary Pattern (LBP) texture descriptors. The system achieved a validation accuracy of 93.5% and a training accuracy of 94.72% after 100 evolutionary generations, outperforming CNN from scratch (82.3%), ResNet-50 (91.2%), and EfficientNet-B0 (92.1%), while also demonstrating superior training efficiency at 3.2 hours compared to all baselines. Real-world testing under varied lighting conditions yielded an average accuracy of 88.4%, confirming adequate generalization capability for practical deployment. Explainability analysis through affinity-based feature contribution maps revealed that classification errors between visually similar classes particularly tempeh and tofu stem from near-identical HSV color distributions and LBP texture patterns, providing a clear direction for future refinement. The system is integrated into a mobile application capable of detecting ingredients from images and recommending recipes that prioritize the use of near-expiry items, offering a practical digital solution to reduce household food waste.

Keywords : AISA, Artificial Immune System, Food Ingredient Detection, Recipe Recommendation, Food Waste, Expiry Date.

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FOREWORD

Praise be to Allah SWT for all His graces, guidance, and gifts to the author so that the thesis with the title " OPTIMIZATION OF DAILY FOOD COMBINATIONS FOR DIABETICS USING THE ARTIFICIAL IMMUNE SYSTEM ALGORITHM METHOD " can be completed properly and on time. The author expresses his deepest gratitude to all parties who have helped both directly and indirectly during the *process of preparing this thesis. In particular, the author would like to thank the:*

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The author realizes that in the preparation of this thesis there are still shortcomings. Therefore, constructive criticism and suggestions from various parties are highly expected for the perfection of this work. Finally, with all the limitations that exist, the author hopes that this thesis report can provide benefits for all parties, especially in the development of science in the field of digital image processing and artificial intelligence.

Surabaya, 20 August 2026

Fajar Chandra Aditiya

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