DESIGN AND DEVELOPMENT OF DOUGH PROOFER MACHINE FOR SMI BAKERY INDUSTRY

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This report is submitted
in fulfillment of the requirement for the degree of
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DECLARATION

I declare that this project report entitled "Design and Development of Dough Proofer Machine For SMI Bakery Industry" is the result of my own work except as cited in the references

Signature : …….

Name : AHMAD SALLEHUDDIN BIN ADNAN

Date : …….

APPROVAL

I hereby declare that I have read this project report and in my opinion, this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design and Innovation).

Signature : ……

Name of Supervisor : MOHD NAZIM BIN ABDUL RAHMAN

Date : ……

DEDICATION

To my mother for her support of either physical or moral support to me in preparing reports Undergraduate Project (PSM) and also my late father.

ABSTRACT

This project aims to improve existing dough proofer in term of its size, capacity, cost saving and working principle and also to apply the integration of cooling rack with the dough proofer. This is because the current dough proofer is big and bulky, and also already equipped with the fixed rack which can only proof a little amount of dough at a time. Through this project, a prototype will be fabricated and tested to determine the performance of the dough proofer machine that affected by two factors that affecting proofing process; temperature and humidity. To ensure the project are achieved in accordance with the scope and objectives, the problem statement has been identified and previous scientific studies have been used as a reference. After conducting a short interview with the baker and reviewing the customer's requirements, the decision to implement a conceptual design of dough proofer machine has been made. Then, the general shape and dimension of the design have been chosen and transient thermal analysis has been done in order to get the predicted results before running the actual prototype testing. Having identified the components and material needed, the prototype been fabricated and tested to obtain the results and compared to the theoretical data from the literature review and also calculated the overall cost for producing the prototype. Based on the prototype testing, the results are 37.1 ˚C for the temperature and 49% for the humidity which the prototype does not reaches its optimum temperature and humidity for the proofing process. It is due to the lack of temperature and humidity sources and also the errors when fabricate the prototype. The prototype also is cheaper compared the existing dough proofer machine in the market. To improve this dough proofer machine, the heat source and humidity of the dough proofer machine should be converted to a source with a better performance level. Additionally, the selection of appropriate materials should be considered to replace the material used in the prototype and reduce the cost of producing a better dough proofer machine.

ABSTRAK

Projek ini bertujuan untuk meningkatkan proofer doh yang sedia ada dari segi saiz, kapasiti, penjimatan kos dan prinsip kerja dan juga untuk menggunakan integrasi rak penyejukan proofer doh. Ini kerana proofer doh yang sedia ada adalah besar dan tebal, dan juga telah dilengkapi dengan rak tetap yang hanya boleh memerap doh dalam jumlah yang sedikit pada satu masa. Melalui projek ini, prototaip akan direka dan diuji untuk menentukan prestasi mesin proofer doh yang dipengaruhi oleh dua faktor yang mempengaruhi proses pemerapan; suhu dan kelembapan. Untuk memastikan projek ini tercapai selaras dengan skop dan objektif, pernyataan masalah telah dikenal pasti dan kajian saintifik terdahulu telah digunakan sebagai rujukan. Selepas menjalankan temu bual pendek dengan pembuat roti dan mengkaji keperluan pelanggan, keputusan untuk melaksanakan reka bentuk konsep mesin proofer doh telah dibuat. Kemudian, bentuk umum dan dimensi reka bentuk telah dipilih dan analisis haba fana telah dilakukan dalam usaha untuk mendapatkan hasil yang diramalkan sebelum menjalankan ujian prototaip sebenar. Setelah mengenal pasti komponen dan bahan yang diperlukan, prototaip telah dibina dan diuji untuk mendapatkan keputusan dan dibandingkan dengan data teori dari kajian literatur dan juga kos keseluruhan untuk menghasilkan prototaip dikira. Berdasarkan ujian prototaip, keputusannya adalah 37.1 C untuk suhu dan 49% untuk kelembapan, dimana ia tidak mencapai suhu dan kelembapan optimum untuk proses pemerapan. Ia adalah disebabkan oleh kekurangan sumber suhu dan kelembapan dan juga kesilapan semasa fabrikasi prototaip. Prototaip juga adalah lebih murah berbanding mesin proofer doh yang sedia ada di pasaran. Untuk meningkatkan mesin proofer doh ini, sumber panas dan kelembapan bahagian mesin proofer doh haruslah ditukar kepada sumber yang mempunyai tahap performance yang lebih baik. Selain itu, pemilihan bahan-bahan yang sesuai perlu dipertimbangkan untuk menggantikan bahan yang digunakan dalam prototaip dan mengurangkan kos untuk menghasilkan mesin proofer doh yang lebih baik.

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In the name of Allah, Most Gracious and Most Merciful. Peace and blessings are upon Prophet Muhammad looked after and family and all his companions. Thank God for giving me enough health, age and maturity of mind to complete the study in such a way.

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LIST OF ABBREVIATION

CO_2	Carbon dioxide
HOQ	House of Quality
PDS	Product Design Specification
CAD	Computer-Aided Design
EC	Engineering characteristics
SMI	Small Medium Industry
BOM	Bill of Material

LIST OF SYMBOL

n.d.	No date
˚C	Degree Celsius
˚F	Degree Fahrenheit
%	Percentage
m	Metre
kg	Kilogram
RM	Ringgit Malaysia
n/a	Not available
V	Volt
mm	Millimetre
ft	Feet

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter begins with the description of the background of the study and an explanation of why the project is carried out in the first section. The next section focuses on the problem statement for this study in more detail which led to this investigation. The objectives of this study are described in the next section. The scope of the research project will be described in the next section.

1.2 BACKGROUND

Bakery industry was begun when humans recognise the usage of grain as a food ingredient. Despite the passage of time and technology occurred rapidly, but the basic ingredients of bread making are not much changed over the years. There were plenty bakery industries around Malaysia. Customer demand for bread making has led to a rapid bakery industry in Malaysia. This is because bread is one of the foods that easy to eat anywhere besides it also gives nourishment and energy to humans.

There are many types of combination and proportions of the bread making ingredients which led to the variety, appearance, size and texture of the bread. The basic ingredients used to make bread are flour, sugar, yeast, powdered milk, water and eggs. All these ingredients will be mixed becoming dough. To make bread, there are several techniques which are mixing, proofing and shaping, and lastly is baking (Bernstein, 2014).

Proofing is one of the techniques which the final rise dough undergoes before it is baked. It is also the central process used for the leavening of bread, pastry and yeast dough (Bernstein, 2014). The dough will undergo proofing inside the dough proofer machine; a machine with warming chamber used in baking that encourages fermentation of dough by

yeast through two elements which are temperatures and humidity. A dough proofer machine usually consists of the heating element, humidity element, a chamber for holding dough and a door for accessing the chamber as shown in Figure 1.1 (Sanders et al, 2006). The existing dough proofer machine requires more energy from the bakery to relocate the completed dough after proofing to another process (Sanders et al, 2006). It also having difficult to clean after proofing process (O'Donnell, 2016). Moreover, most the bakery uses the rack type dough proofer as shown in Figure 1.2. The proofer has limited spaces and only proof the dough in small quantity in a time based on a number of racks.

To solve the problems, this project will improve and fabricate the new dough proofer machine. This new dough proofer machine will be designed with cost effective and can be integrated with the cooling rack.

Figure 1.1: Existing dough proofer machine
(Source: Ziq Bakery & Cake, 2016. Reprinted with permission)

Figure 1.2: Inside of the dough proofer machine
(Source: Ziq Bakery & Cake, 2016. Reprinted with permission)

1.3 PROBLEM STATEMENT

The main problem of the existing dough proofer was big and bulky in size. Moreover, the weight of the dough proofer was too heavy. It makes the baker difficult to arrange and place the proofer in the shop of the factory and also it takes more spaces. In addition, the bigger size of the dough proofer will make the baker difficult to cleanse the proofer after the proofing process.

The other problem in existing dough proofer is it already equipped with the fixed rack. Some of the proofers have only certain amount of rack. It will take time for the dough

to proof if the bakery using the small amount of rack for the proofer thus the production of dough become slower.

1.4 OBJECTIVE

The objectives of this project are as follows:

1. To improve an existing dough proofer in term of its size, capacity, cost saving and working principle.
2. To apply the integration of cooling rack with the dough proofer.

1.5 SCOPE OF PROJECT

The scopes of this project are:

1. The designing of the dough proofer that can be integrated with the cooling rack.
2. Fabricate and analyse the dough proofer.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter describes all the information about dough proofing technique to make bread. All relevant information in proofing of dough has been searched and analysed through some literature and several journals, websites and a brief interview with bakery entrepreneur with experience in that field.

2.2 PROOFING PROCESS

The term proofing or fermentation of dough refers to the process where the yeast dough undergoes activity of breaking the carbohydrates found in wheat and some other materials into alcohol and some acids. At the same time, the gas carbon monoxide (CO_2) will be liberated and trapped in the dough to makes the dough rise (Sariroti, 2016). This process is performed after once all the materials undergoing the process of kneading. The proofing or fermentation process for the production of bread has been done long ago. This stage is to produce a piece of bread with the porous and softer texture of the bread. The yeast is finally inactivated by the heat in the oven.

Figure 2.1: Dough condition before (Left) and after (Right) proofing process. (Source: Hemer, 2013)

2.2.1 Dough description

The dough is the mixture of several ingredients which are mainly flour, water yeast, salt, and some addition ingredients. In order to make perfect dough, the amount of the ingredients must be correct. Yeast is the most key element in this proofing process. It will rise and strengthen bread dough. The perfect combination of the ingredients and parameters such as temperature and humidity will cause the yeast cell to reproduce when exposed. The functions of the yeast are shown in Figure 2.2.

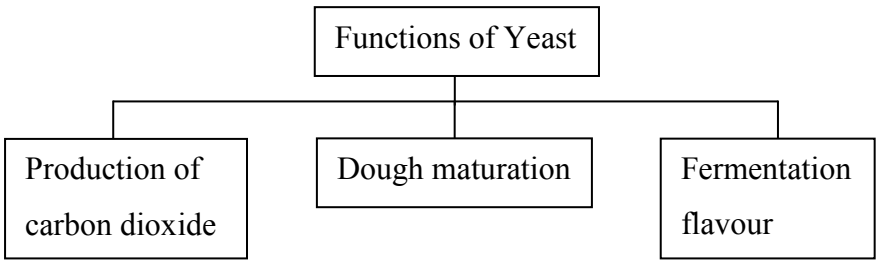

Figure 2.2: Functions of yeast
(Source: Functions of Yeast in Baking, n.d.)

The yeast activities will break down the sugar in the dough and result in producing carbon dioxide. This gas will cause the expansion of the dough as the gas trapped within the protein matrix of the dough. The chemical reaction of yeast produced alcohols and acids on the protein of the flour and also produced carbon dioxide which makes the structure of the dough become light and airy. The alcohols

from the reaction of the yeast also will enhance the flavour to the dough ("Fermenting your dough," 2015)

2.2.2 Factors that affect proofing

No specific time was allotted for the dough expands ("How Long Should My Bread Rise? " n.d.). Occasionally in proofing process takes a long time for a few hours to develop the dough. To make sure the dough is completely proofed, the ripe test was used by sticking two fingers into the dough and take out. The indentations of the dough will show that the dough is completely raised enough ("Baking Steps Guide," n.d.). However, time is not a very important factor in this proofing process. The factors that are affecting the proofing are temperature and humidity.

2.2.2.1 Temperature

Temperature shows the greatest effects on the dough raised size. The temperature will control the yeast's activity of releasing the carbon dioxide. The reaction of yeast will increase the temperature but it will stop when the temperature is reach around 60˚C ("Yeast Treatise - Dough Fermentation & Temperature," 2001).

Due to the effectiveness of the proofing process depends on the amount of yeast in the bread and temperature conditions. Yeast is active at a temperature in the range (Cauvain and Young, 2001). Proofing process can be shortened by raising the temperature in the active environment. The best temperature of the dough to proof is 35˚C and gas production increases as the temperature rise to 38˚C ("Yeast Treatise - Dough Fermentation & Temperature," 2001). S. Hannan (2014) found that the suitable temperature to proof is 40˚C. The temperature of 115˚F (46˚C) would take a shorter time to proof the dough compare to a temperature below it but higher that 115˚F will affect the texture of dough as shown in Figure 2.3. However, the optimum temperature for producing bread is among the range.