

**BUSITEMA  
UNIVERSITY**  
*Pursuing Excellence*

**FACULTY OF ENGINEERING**

**DEPARTMENT OF AGRO-PROCESSING ENGINEERING**

**DESIGN AND CONSTRUCTION OF A PEDAL POWERED DOUGH MIXER.**

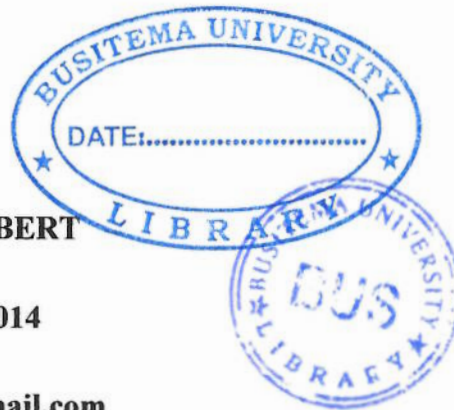
**BY**

**OKALANY GILBERT**

**BU/UP 2014/2014**

**okalanygilbert@gmail.com**

**+256785722309/758622651**



**SUPERVISOR: Mr. SSERUMAGA PAUL.**

*A final year project submitted as partial fulfillment of the requirements for the award of a  
Bachelor of Science in Agro-processing engineering*

**MAY, 2019**

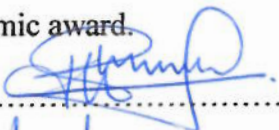
## ABSTRACT.

An efficient dough mixing helps to; increase bread quality, production performance of bread, minimize time wastage, prevent labor drudgery. The objectives of this research were to design and assemble different components, test the performance and to carry out cost benefit analysis of the prototype. The dough mixed was ready enough for use and the prototype is designed ready for production with the provision for repair and maintenance by the small and medium scale producers of bread. In this research, a motorized dough mixer was designed and fabricated. The machine essentially consists of a single phase electric motor with a design capacity of 70kg/hr for 6kg per batch 70kg/hr. The machine works on the principle that the gearbox reduces the motor speed to suit relatively high torque required during agitation. The dough is then manually removed from the mixing bowl. A pedal powered dough mixer prototype operated manually by peddling using human labor. The prototype had an efficiency and design capacity of 75% 40kg/hr respectively. During testing I discovered that the prototype works best for 3kg per batch. There was no any loss obtained during the mixing operation. The principle of operation of the prototype is based on the energy transmission from the pinion of the convectional bicycle unit to processing unit through the rotary shafts. From the economic evaluation using the net present value method with a huddle rate of 10% , with the Net present Value of 31,890,517 *uganda shillings*.The machine efficiency was influenced by the feed quantity of wheat flour mixing proportions. The operation requires technical skills for its smooth operation especially in aligning the mixing bowl base from the bottom level of the agitator.

**Key words:** wheat flour, mixing bowl, dough mixer and dough.

**DECLARATION**

I Okalany Gilbert, hereby declare, to the best of my knowledge, that this research project report is an outcome of my original work and that it has not been presented to any institution of learning for an academic award.

Signature:  .....

Date: 15/05/2019 .....



**APPROVAL**

This piece of work has been approved by;

Supervisor: Mr. SERUMAGA PAUL

Signature.....

Date.....

## ACKNOWLEDGEMENT

I am very grateful to the Almighty God for the protection, guidance and good health He has provided to me.

Sincere appreciations to Higher Education Students' Financing Board (HESFB) for financing my tuition and functional fees for all these years.

I appreciate my parent for the support that they extend to me in order to attain quality education. May the Almighty God bless the work of her hands.

I do give great gratitude to my supervisor Mr SERUMAGA PAUL and the Head of Department Madam KABASA MARY SSALLY; who have worked tirelessly to see that my final year project becomes successful. May God bless you abundantly.

## TABLE OF CONTENTS

ABSTRACT.....	ii
DECLARATION.....	iii
APPROVAL.....	iv
DEDICATION.....	v
ACKNOWLEDGEMENT.....	vi
LIST OF FIGURES.....	x
LIST OF TABLES.....	xi
CHAPTER ONE.....	1
1.0 INTRODUCTION.....	1
1.1 BACKGROUND OF THE STUDY.....	1
1.2 PROBLEM STATEMENT.....	2
1.3 JUSTIFICATION.....	2
1.4 PURPOSE OF THE STUDY.....	2
1.5 OBJECTIVES OF THE STUDY.....	3
1.5.1 Main objective:.....	3
1.5.2 Specific objectives were:.....	3
1.6 SCOPE OF THE STUDY.....	3
2.0 CHAPTER TWO:.....	3
LITERATURE REVIEW.....	3
2.1 Introduction.....	3
2.2 Production of wheat in Uganda.....	3
2.3 Wheat Grain anatomy and structure or kernel.....	4
2.4 Whole wheat grain varieties.....	5
Triticum aestivum.....	5
2.5 Whole wheat flour.....	6
2.6 Chemical composition of wheat kernel/whole wheat grain flour.....	7
Whole wheat flour streams and extraction rates.....	8
2.7 Nutritional value of the whole wheat grain/flour.....	9
2.8 Post-production Operations.....	10
2.9 Dough.....	11
2.9.1 Microstructure of dough.....	11

2.9.2 Preparation of bread like Chapatti.....	12
2.10 Over view of existing dough mixing methods.....	13
2.10.1 Traditional hand mixing method.....	13
Dis advantages of this method .....	14
Disadvantages of this method .....	14
2.11 Financial Analysis Techniques .....	14
2.11.1 Simple payback .....	14
2.11.2 Simple rate of return.....	15
2.11.3 Life-cycle analysis.....	15
2.11.4 Present value (PV)/present worth analysis.....	15
2.11.5 Profitability Index.....	16
CHAPTER THREE:.....	17
3.0 METHODOLOGY .....	17
3.1 Introduction .....	17
3.2 The conceptual drawing.....	17
3.3 Machine description and its Mode of operation.....	18
3.4 Mode of operation.....	18
3.5.1 Design parameters .....	18
3.5.2 Design considerations.....	18
Specific objective one: Design of the prototype components .....	19
3.6.1 Mixing Bowl design .....	19
3.6.2 chain design .....	21
3.6.3 Design of the shaft .....	23
3.6.5 Design of Bearing Caps and Bolts.....	26
3.6.6 Design of the drive mechanism.....	28
3.6.7 Power requirements of the machine .....	28
3.6.8 Design of a frame .....	29
Design assumption:.....	29
3.7.0 Specific objective two: .....	29
3.7.1 Prototype fabrication and assembly .....	29
Measurement and marking out process.....	30
Machining process .....	30
Assembly and Joining process.....	30

3.8.0 Specific objective three: Testing the performance of the prototype.....	30
3.9.0 specific objective four: Cost benefit analysis of the machine.....	32
3.8.1. Cost-Benefit Analysis.....	32
3.8.2 Determination of the costs and cash flows.....	33
CHAPTER FOUR.....	36
4.0 RESULTS AND DISCUSSION.....	36
CHAPTER FOUR.....	36
4.0 RESULTS AND DISCUSSION.....	36
4.1.0 Results.....	36
4.1.1 Design results.....	36
4.1.2 Construction Results.....	37
4.1.3 Test Results.....	38
4.1.4 Economic analysis results.....	39
4.2 Results Discussion.....	41
CHAPTER FIVE.....	42
5.0. CONCLUSION AND RECOMMENDAATIONS.....	42
5.1. CONCLUSION.....	42
5.2 Recommendations.....	42
REFERENCES:.....	43



## LIST OF FIGURES

Figure 1:shows wheat grain structure (from Encyclopaedia Britannica, <a href="http://www.britannica.com">http://www.britannica.com</a> ).....	5
Figure 2:shows the CLSM (Confocal Laser Scanning Microscopy) diagram of the dough of organically grown wheat.....	12

## LIST OF TABLES

Table 1:shows Classification of wheat grain and their end use .....	6
Table 2:shows chemical composition of wheat kernel parts (% Dry-Weight Basis).....	7
Table 3: shows Chemical Composition (%) of Endosperm, Bran and Germ (on 14% moisture basis).....	8
Table 4: shows chemical composition of flour with respect to extraction rate.....	9
Table 5 below: Showing the production cost of the machine .....	33
Table 7: Showing the design results of the study .....	36

## **CHAPTER ONE**

### **1.0 INTRODUCTION**

This chapter briefly gives the background to the study topic, the problem statement, the objectives of the project, the reasons as to why the project should be carried on (justification), giving its purpose and finally the scope or limits of the project.

### **1.1 BACKGROUND OF THE STUDY**

Bread is a dietary staple in human nutrition and one of the oldest foods. Bread as a food is highly consumed domestically during breakfast and dinner meals. Bread is rich in diverse nutrients such as: carbohydrates, proteins, fats, mineral substances, B-complex vitamins, vitamin E and other valuable diet components (Arent, 2008).

Bread making is surprisingly simple and good results are certain if one understands well all the stages of making bread (Iorna Walker and Joyce Hughes). Many ingredients may be included in bread in addition to the basic ingredients of flour, water, leavening and salt, to increase its nutritional value (Khurmi, 2003). Many vitamins are sensitive to light, temperature, and moisture, so milling, processing, and storage conditions affect their stability. B vitamins are susceptible to destruction by heat (Leroy, 2004). The high proportional contribution of bread to the human diet satisfying over 50% of energy requirements necessitates that particular attention should be given to bread quality. Therefore, the technology used in making this bakery product is receiving increasing attention. Bread-making technology has been changing for years (Kerr, 2009). Bread is prepared from composite flours and 100% wheat control flours were prepared using straight dough method (American Association of Cereal Chemists, 2000). The process stages followed in bread preparation include; Dough mixing, fermentation, scaling and dividing, intermediate proofing, Baking, Cooling, slicing and packaging. The very first step is the preparation of dough. The various ingredients are correctly measured per the formulation and then the dough is prepared (Bakery Technology and Manufacture). There are two methods of preparing dough viz; the straight dough method and the sponge dough method. However, in method dough undergoes the following mixing stages include the pickup, initial development, cleanup, final development and letdown and breakdown stages.

## REFERENCES:

- Austin, A and Ram, A. 1971.** *Studies on chapatti making quality of wheat.* New Delhi : Indian Council of Agricultural Research. Tech. Bull. No.31, ICAR, 1971.
- Baloch, U. K. 1994.** *Post-Production Systems in Pakistan. Expert Consultation in regional Priorities and Co-operation in Post-Harvest Systems in Asia.* Bangkok, Thailand. : FAO/RAPA., 1994.
- Belderok, B, Mesdag, H and Donner, DA. 2000.** *Bread-Making Quality of Wheat.* Springer, New York : s.n., 2000.
- Dennis, R. buckmaster, et al. 2005.** *Chains for power transmission and material handling 2nd Ed.* Rock Ville, MD : American Chain Association, 2005.
- Dobraszczyk, B.J and Morgenstern, M. 2003.** *Rheology and the breadmaking process.* s.l. : Journal of Cereal Science 38(3), 229-245., 2003.
- J.K.GUPTA, R.S. KHURMI and. 2005.** *MACHINE DESIGN.* RAM NAGAR, NEW DELHI 110 055 : EURASIA PUBLISHING HOUSE (PVT) LTD, 2005.
- Leelavathi, K, Haridas Rao, P and and Shurpalekar, R. 1986.** *Test baking of chapati-development of a method.* *Cereal Chemistry* 63(4): 297-303. 1986.
- Li, W., Dobraszczyk, B.J. and & Schofield, J.D. 2003.** *Stress relaxation behaviour of wheat dough and gluten protein fractions.* *Cereal Chemistry* 80, 333-338. 2003.
- Lindsay, DG, et al. 2002.** *Phytochem, J. Nutr. Field Crops.* s.l. : Rev. 1: 101–111; 132: 495S499S; Res. 60: 57–80, 2002.
- Lindsay, M.P and Skerritt, J.H. 2000.** *Immunocytochemical localisation of gluten proteins uncovers structural organization of glutenin macropolymer.* s.l. : *Cereal Chemistry* 77(3), 360369., 2000.
- Mackintosh, S.H., et al. 2009.** *Wheat glutenin proteins assemble into a nanostructure with unusual structural features.* . s.l. : *Journal of Cereal Science* 49(1), 157-162., 2009.

