



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

**FACULTY OF ENGINEERING
DEPARTMENT OF CHEMICAL AND PROCESSING
ENGINEERING**

**FINAL YEAR PROJECT REPORT
DESIGN AND CONSTRUCTION OF A MILLING MACHINE FOR
MILLING OF COCOA PRESS CAKE INTO MICRO-PARTICLE
POWDERS**

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Abstract

Cocoa is one of the most important agricultural export commodities in the world and the fundamental ingredient in chocolate manufacture. Cocoa beans are mostly processed into chocolate and cocoa products using a wide range of intermediate products such as cocoa liquor, cocoa butter, cocoa cake and raw cocoa powder. Cocoa powder is obtained by pulverizing the cocoa press cake which remains after the extraction of cocoa butter from cocoa paste and is essentially used in flavouring biscuits, ice cream and other dairy products, drinks and cakes and in the manufacture of coatings for confections and frozen desserts and is also used in the beverage industry. Cocoa powders are increasingly demanded for their pre-discussed functions not only as mere powder but rather in a finer form or micro-particle size. The need for micro size milling is because particle size influences many properties of particulate materials like powders, suspensions and is a valuable indicator of quality. The size of powders influences the dissolution property as smaller particles dissolve more quickly and lead to higher suspension viscosities than larger particles. Micro particles are particles with dimensions between $1 * 10^{-7}$ and $1 * 10^{-4}$ m. and are obtained by milling using; jet mill, mechanical mills (hammer mills), and stone mills. However stone mills generate considerable heat due to friction which can result in considerable damage to protein and jet mills have lower productivity, large equipment size and high process gas flow.

Therefore the objective of this study was to design and construct a milling machine for milling of cocoa press cake into micro particle powder and that is locally available. The methods used for achieving the objective were making engineering drawing of the parts, fabricating the parts and their assembly to form the complete machine.

The designed cocoa press cake milling machine was constructed, tested with the milling efficiency of 79.5% and loss of 20.5%, through put of 34.5kg/hr. It can be used by local entrepreneurs for running a business and to earn a living from it.

Declaration

I, **Osiku Samuel**, hereby declare that this report is the original copy of the work compiled from various literatures gathered from different sources. It has never been submitted before, for the award of Bachelor's degree in Agro-Processing Engineering or any award of the same kind.

Signed: 

Date: 30th May 2017



Approval

This report has been submitted to the Department of Agro-Processing Engineering for examination leading to the award of Bachelor of Science in Agro-Processing Engineering with my approval.

Main supervisor

Mr. SSERUMAGA PAUL

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Signed:

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1.0 CHAPTER ONE: INTRODUCTION

This project is undertaken to solve a problem of milling cocoa press cake into micro-particle powder. This chapter accounts for the background, problem statement, purpose, objectives, justification and scope of the study.

1.1 Background to the Study

Cocoa beans are the seeds of the tropical cacao tree, *Theobroma cacao*, family *Sterculiaceae*. Cocoa is one of the most important agricultural export commodities in the world. Cocoa beans are the fermented and dried seeds of *Theobroma cacao*, and the fundamental ingredient in chocolate manufacture. It is generally known to have originated from Central and Southern America. Currently, three broad cultivars of cocoa are commonly recognized: *Forastero*, *Criollo* and *Trinitario*. The cultivars exhibit differences in the appearance of pods, yields of beans, flavour characteristics and in resistance to pests and disease (*Wood and Lass 1985; Asiedu 1989; Afoakwa et al. 2008; Afoakwa 2010; Adeyeye et al. 2010*). Cocoa is largely produced in developing countries, but is mostly exported to and consumed in industrialized countries. Cocoa beans are mostly processed into chocolate and cocoa products using a wide range of intermediate products such as cocoa liquor, cocoa butter, cocoa cake and raw cocoa powder. Cocoa powder is obtained by pulverizing the cocoa press cake which remains after the extraction of cocoa butter from cocoa paste. Cocoa powder is essentially used in flavouring biscuits, ice cream and other dairy products, drinks and cakes and in the manufacture of coatings for confections and frozen desserts (*Afoakwa et al. 2007; Pandey and Singh 2011; Frost et al. 2011; Rossini et al. 2011; Ardhana and Fleet, 2003*). It is also used in the beverage industry, for example in the preparation of chocolate milk. Cocoa butter is used in the manufacture of chocolate confectionery, soap and cosmetics (*Ntiamoah and Afrane 2008; Schumacher et al. 2010*). Other by-products such as cocoa pulp juice is also fermented to produce industrial alcohol and alcoholic beverages such as brandy and wine (*Jayathilakan et al. 2011*).

Processing of cocoa beans into various cocoa and chocolate products starts with an on-farm fermentation of the beans followed by drying, and roasting during industrial processing. These postharvest processes are very crucial to the quality of finished products as they initiate the formation of chocolate flavour precursors and the brown colour of cocoa products (*Schwan et al. 1995; Adeyeye et al. 2010*). The fermentation process breaks down the mucilaginous pulp surrounding the beans and causes cotyledon death (*Sanchez et al. 1985;*

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