



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

**FACULTY OF ENGINEERING
DEPARTMENT OF AGRICULTURAL MECHANIZATION AND
IRRIGATION ENGINEERING**

**DESIGN AND CONSTRUCTION OF A MULTIPURPOSE PINEAPPLE
PROCESSING MACHINE**

BY

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APPROVAL

This project report is submitted to the Faculty of Agricultural Mechanization and Irrigation Engineering (AMI) of Busitema University as a partial fulfillment of the requirements for the Degree in Bachelor of Agricultural Mechanization and Irrigation Engineering with the approval of the following supervisors:

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DECLARATION

I OKELLO BONIFACE hereby declare this project report entitled "Multipurpose Pineapple Processor" is the results of my own research except as cited in references.

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ABSTRACT

Pineapple fruit (*Ananas comosus*) is highly perishable in its natural state after harvest and is vulnerable to spoilage by mechanical damage, chemical deterioration and environmental effects. Thus, it is highly essential to process the freshly harvested fruit into juice which can be consumed freshly or processed further into healthful beverages.

Design considerations included: high processing capacity and efficiency, quality of juice, quality, availability and cost of construction materials. The main design features involved pulley and belt design, worm shaft design, design for capacity, power requirements and prime mover selection. The major components of the machine were peeling table, chopping unit, extraction unit, juice outlet, waste outlet, frame, prime mover (electric motor) and motor stand. The chopping unit consists of a shaft attached with spikes which chop whole pineapple fruit into smaller pieces and convey the chopped product to the position where it enters the extraction unit through a lower hopper. The extraction chamber houses a shaft which conveys, crushes, grinds and presses the product from the chopping unit.

The juice extracted is drained through the juice sieve into the juice outlet from where it is collected while the residual waste is collected at the waste outlet. The machine was tested using freshly harvested whole pineapple fruits and result revealed a juice yield, extraction efficiency and extraction loss of 57.8, 77.9 and 51.2 % respectively. Powered by a 2 hp single-phase electric motor, the machine has a production cost of UGX (1,033,000 OR 1,563,000) when the motor is hired or bought with the construction materials being locally available at affordable costs. A cottage pineapple juice extraction plant based on this technology can provide employment for at least two persons at the same time providing fresh juice at low costs and residual waste as an ingredient for livestock feed manufacturing.

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DEDICATION

I dedicate this report to my parents Mr. Olule John Naputali and Mrs. Florence Olule and my best friend Mr. Cong Serafino for the encouragement, moral and financial support they have all heartedly given to me during the entire academic struggle.

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LIST OF ACRONYMS

DFID.....	Department for International Development
FFS.....	Farmer Field Schools
MAAIF.....	Ministry of Agriculture Animal Industry and Fisheries
NOGAMU.....	National Organic Agriculture Movement of Uganda
TODFA	Tororo District Farmers Association
UNIDO	United Nations Industrial Development Organization
UEPB.....	Uganda Export Promotion Board
NAADS.....	National Agricultural Advisory Services
MSMEs.....	Medium and Small Micro Enterprises
Hapco.....	Hawaiian Pineapple Company

CHAPTER ONE

1.0 INTRODUCTION

This chapter covers the general information for the project title “Multipurpose Pineapple Processor” like background and overview of the project, problem statement, project aim and objectives, justification and scope for this project.

1.1 Background of the study

Pineapple/*Ananas comosus* as it is scientifically known belongs to the Bromeliaceous family originated in America, but it was the Europeans who first discovered this tropical fruit in the 1600's. The cultivation of this plant spread far and wide to all tropical regions of the world.

Due to its tropical location, Uganda is endowed with a wide variety of succulent, tropical fruit. Fruits contribute a big share of the country's non-traditional agricultural exports and to the nation's exchange economy. According to the FAO (2004) Uganda produced only 0.35% of total pineapple production for East Africa compared to 80% and over 19% produced in Kenya and Tanzania respectively. Forty percent of pineapples produced in Uganda are exported into the regional market of Democratic Republic of Congo, Rwanda and Kenya.

1.1.1 Areas where pineapple is grown in Uganda

Pineapples in Uganda are generally grown as a sole crop or an intercrop with bananas. Pineapple is mainly grown in Kayunga, Tororo, Luwero, Kamuli, Mpigi, Sembabule, Kenjojo and Iganga.

1.1.2 Pineapple selling in Uganda

In Uganda pineapple is sold in different products in local markets, to juice extraction companies and fruit exporters.

Farmers in Kayunga and Luwero districts are drying the fresh pineapples and selling the solar dried products to exporters such as Fruits of the Nile, FLONA Commodities Ltd and AMFRI Farms Ltd. Drying of these pineapples is mainly done during the peak (bumper harvest) season. Generally, smallholder producers, with little or no cash input using only family labour, net revenue is estimated at total revenue of annual earnings of Ushs 6–10 million/ha, (where 20,000 fruits were planted and sold at Ushs 300 -500/fruit) to local markets (Ssonko *et al.*, 2005).

REFERENCES

www.niae.net/journals/vol14fullpage.pdf

<http://www.youtube.com/watch?V=8OhHIBIRfg>

www.webstaurantstore.com/spresheets/591557751.pdf

<http://cms.cnr.edu.bt/cms/files/docs/File/Jeanette/PDF/Pineapple%20Postharvest%20operations%28harvesting%29pdf.pdf>

<http://www.aliexpress.com/wholesalescrewpres...ml?productId=523791932&src=sc&af=RelatedProduct&isdl=y>

www.webstaurantstore.com/specsheet/591557751.pdf

http://www.alibaba.com/productgs/700117782/Multifunction_Pineapple_Juice_Extractor_Machine_0086/showimage.html

http://www.alibaba.com/productgs/1277390528/2013_industrial_pineapple_juice_extractor_machine/showimage.html

http://www.unido.org/fileadmin/32382_fruitsDec21.2.pdf

<http://www.kau.edu/prsvkm/Docs/Benefitsanduseofpineapple.pdf>

www.medwelljournals.com/abstract1?doi=rjasci-2007.31.34

Ndubisi A. Aviara, Abubakar A. Lawal, Davou S. Nyam & Jesutofunmi Bamisaye:

DEVELOPMENT AND PERFORMANCE EVALUATION OF A MULTI-FRUIT JUICE EXTRACTOR; Department of Agricultural and Environmental Resources Engineering, University of Maiduguri, Maiduguri, Nigeria. Global journal of engineering, design and technology (published by global institute for research and technology)

Olaniyan A. M: DEVELOPMENT OF A SMALL SCALE ORANGE JUICE EXTRACTOR: Revised: 16 October 2008 / Accepted: 13 June 2009. Association of Food Scientists and Technologists (India), Mysore

Olaniyan A.M & Babatunde O.O (2012), Development of a small scale pineapple juice extractor using a screw pressing system. Advanced Materials Research, 367, 699-709.

Madison, Wisconsin (1999), WOOD HANDBOOK: Wood as an engineering material. US.

Department of Agriculture.

Olaniyan, A. M. (2010). Development of a small scale orange juice extractor. Journal of Food Science and Technology, 47, 1, 105-108.

Oyeleke, F. I., & Olaniyan, A. M. (2008). Extraction of juice from Some tropical fruits using a small scale multi-fruit juice extractor. African Crop Science Proceedings, 8, 1803-1808.

Shigley, J. E. & Mischke, C. R. (2001). Mechanical engineering design, (Ed.). New York: McGraw-Hill Book Company, 1248 pp.

Tressler, D. K. & Joslyn, M. A. (1961). Fruit and vegetable juice technology (Ed.). Connecticut: AVI Publishing Company Inc, p 155-158.