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FACULTY OF ENGINEERING

DEPARTMENT OF AGRO-PROCESSING ENGINEERING

FINAL YEAR PROJECT REPORT

Optimization of the maize drying parameters, a strategy to increase maize shelf life

BY

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A Research Project Proposal in Partial Fulfillment of the Requirement for the Award of the Degree of Bachelor of Science of Agro-Processing Engineering in the Faculty of Engineering of Busitema University

DECLARATION

I, MUKISA Moses declare that the work presented in this proposal is my own and has never been presented to any university or higher institution of learning for any academic award.

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Date.....*6/May/2014*.....



APPROVAL


This final year project report has been submitted to the department of Agro-Processing Engineering for examination with approval from the following supervisors:

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ABSTRACT

The shelf life of grains after harvest is greatly determined by its moisture content because the moisture in the grain has influence on water activity of the grain and water activity has influence on lipid oxidation, enzyme activity, non-enzymatic browning, and microbial activity and also influences grain texture. After harvesting the maize grains must therefore be dried as soon as possible since wet grains attract insects and mould (Green et al, 2005).

For drying to be effectively done, all the parameters that affect it need to be optimally controlled. Such parameters include drying temperature, time for drying, and rate of the drying air flow. Variation of such parameters affects the properties of the final dried maize grains and thus affecting its shelf life.

The methodology of this research involved varying different drying parameters combinations in a number of maize samples during the drying process. The shelf life properties such as moisture content, mould action, and degree of wrinkleless of the samples, as well as seed variability of the stored maize samples were tested after a period of 10 days and 20 days

A Graph of time against air temperature was plotted to clearly illustrate how time of maize grain drying varies at different airflow rates and drying air temperatures. Graphs of properties against temperature were plotted, to illustrate how the shelf life determining properties varies in samples dried at different drying parameter combination after given storage time intervals. A graph of germinability against drying temperature was also plotted to determine the level of viability of the maize seeds when dried at different drying parameters.

Results of shelf life were further analyzed with reference to UNBS and EAC Quality Standards. With this, an objective function equation which minimizes the shelf life reducing parameters, P was formulated. The drying parameter combination that minimizes the shelf life reducing properties, P was considered the best that optimizes the maize drying parameters.

From the study conducted on properties that reduce shelf life such as; moisture content, degree of wrinkleness, and mould action; and seed viability of the dried maize grains after storage for a period of 20 days; shelf life can be maximized when maize grains are dried at a temperature of 70⁰C, airflow rate of 0.012m³/s, and for a period of 120 minutes

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DEDICATION

I would like to dedicate my report to my parents who have tirelessly and endlessly supported and encouraged my stay in education. May the almighty God bless and reward them abundantly.

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LIST OF ACRONYMS

EAC	–	East African Community
FAO	–	Food Agriculture Organisation
Kg	–	Kilo Gram
Kwh/m ²	–	Kilo Watt Hour per Square Meter
NARO	–	National Agricultural Research Organisation
REPU	–	Renewable Energy Policy Uganda
S/N	–	Serial Number
UNBS	–	Uganda National Bureau of Standards
UGX	–	Uganda Shillings
WFP	–	World Food Programme

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

The shelf life of grains after harvest is greatly determined by its moisture content because the moisture in the grain has influence on water activity of the grain and water activity has influence on lipid oxidation, enzyme activity, non-enzymatic browning, and microbial activity and also influences grain texture. After harvesting the maize grains must therefore be dried as soon as possible since wet grains attract insects and mould (Green et al, 2005).

Drying refers to the systematic reduction of crop moisture down to safe levels for storage which is usually 12%-15.5% moisture content. Drying which is one of the key post-harvest operations since all down-stream operations depend on it and considered as one of the most critical points within the postharvest processing of maize grain due to its effect on the quality of the final product (Wrigley, 2010). Poor operation of this process may result into substantive losses as action of other defects like mycotoxins becomes inevitable. It is thus imperiously necessary to identify what parameter combination to undertake during drying to eliminate the causes of such deficiencies in quality of grains.

For drying to be effectively done, all the parameters that affect it need to be optimally controlled. Such parameters include drying temperature, time for drying, the relative humidity of the environment where drying is done, and rate of the drying air flow. Variation of such parameters affects the properties of the final dried maize grains and thus affecting its shelf life.

Since 1990, maize has been a cash crop in Uganda with informal exports to the region equivalent to 14-20% of total production. However, it is noted that the maize that is exported from Uganda is seasonal and dominated by wet and unclean maize leading to high levels of moisture content, fungal diseases, discoloured, and potential high Aflatoxin levels due to poor drying procedures practiced as the main criteria effecting quality. Therefore transactions have not been sufficiently successfully as the East African Community Quality standards are normally abused (Magnay, 2004).

REFERENCES

- Ambrose Agona, Jane Nabawanuka H. Muyinza, An overview of maize in Uganda, Post-harvest Programme, NARO Uganda
- A.N. Kaaya, et al. Factors Affecting Aflatoxin Contamination of Harvested Maize in the Three Agroecological Zones of Uganda Department of Food Science and Technology, 2006, department of Crop Science, Makerere University, P.O. Box 7062, Kampala, Uganda
- A.N. Kaaya and W. Kyamuhangire, Drying Maize Using Biomass-Heated Natural Convection Dryer Improves Grain Quality during Storage, 2010, Department of Food Science and Technology, Makerere University, P.O. Box 7062, Kampala, Uganda
- C. W. Wrigley, 2010, Cereal Grains Assessing and Managing Quality edition
- CHUNG, D. S., and CONVERSE, H. H., 1971, Effect of moisture content on some physical properties of grains Trans. ASAE 14(4):612.
- Community Development Trust Fund of Tanzania, 1977: *Appropriate technology for grain storage: report of a pilot project*. New Haven, Economic Development Bureau, Inc.
- Drs. Irene Nakiyimba, 2013, Final Year Research Report Format, Business Systems Integration Expert/Researcher- UICT and MUK
- DUTTA, P. K. 1986. Effects of grain moisture, drying methods, and variety on breakage susceptibility of shelled corn as measured by the Wisconsin Breakage Tester, Ph.D. thesis Iowa State University, Ames, IA
- Farm Electric Centre: *Grain drying and storage*; Warwickshire, National Agriculture Centre.
- <http://www.mycotoxins.com>
- http://www.fao.org/documents/a_guide_to_maize_marketing_for_extension_officers...
agriculture and consumer protection
- <http://www2.ca.uky.edu/agc/pubs/pubs.htm>

John Magnay, 2004, The Ugandan maize Industry, Paper presented at the NEPAD/IGAD regional Nairobi

Ministry of Agriculture, Animal Industry and Fisheries, Maize harvesting and post-harvest handling; National Agricultural Research Organization

Pavol findural et al., 2010; Effect of the drying medium temperature and grain Moisture content on the damage of the food maize grains; Original scientific paper

Prof. Univ. Dr. Eng. Georgeta pop et al, Impact of moisture on mycotoxins Content in maize;

R. Wilfred Odogola, 1991, Post-harvest technology, Uganda

Raşhad A. Suleiman et al., Effects of Deterioration parameters on Storage of Maize, 2013, *Iowa State University*, Kurt A. Rosentrater *Iowa State University*, Carl J. Bern *Iowa State University*,

Rural Structures Unit, 1984: *The improved maize crib: a guide to small farm grain storage*. Volume 1: Theoretical background. Volume 11: Description and drawings. Nakuru, Ministry of Agriculture

Savu C., Georgescu N., 2004, *Siguranţa alimentelor, riscuri şi beneficii*, Ed. Semne, bucureşti.