



شبكة المعلومات الجامعية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



شبكة المعلومات الجامعية
@ ASUNET



شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم



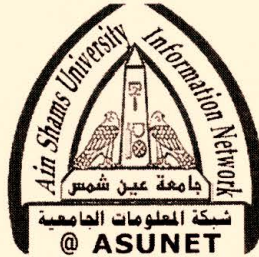
شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of
15-25- c and relative humidity 20-40 %

بعض الوثائق الأصلية تالفة

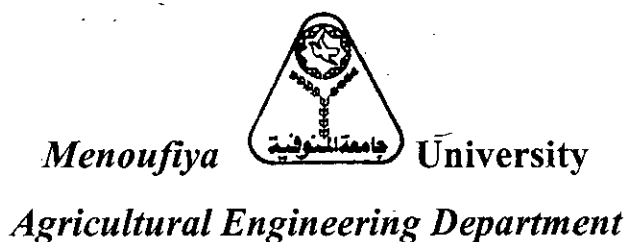
شبكة المعلومات الجامعية
@ ASUNET

بالرسالة صفحات لم

ترد بالاصل



630



**EFFECT OF VIBRATIONS AND HANDLING ON
PROPERTIES OF SOME AGRICULTURAL
PRODUCTS**

By

Mostafa Mohamed Ali Azam

B.Sc. Agric. Engineering. 2001

Thesis

Submitted to the Department of Agricultural Engineering, Faculty of
Agriculture, Menoufiya University

In Partial Fulfillment

Of the

Requirements for the Degree

Of

MASTER OF SCIENCE

In

**Agricultural Science
(AGRICULTURAL ENGINEERING)**

To

**DEPARTMENT OF AGRICULTURAL ENGINEERING
FACULTY OF AGRICULTURE
MENOUEFIYA UNIVERSITY
SHIBIN EL-KOM
EGYPT
2007**

B

٢٨٧٣

ADVISORY COMMITTEE

Title of thesis: EFFECT OF VIBRATIONS AND HANDLING
ON PROPERTIES OF SOME AGRICULTURAL PRODUCTS.

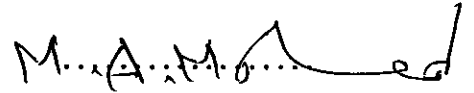
By: Mostafa Mohamed Ali Azam

B.Sc. in Agricultural Engineering, 2001.

Supervision committee:

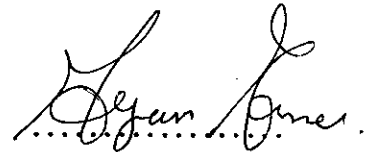
Signature,

Dr. Mahmoud Ali Mohamed



*Professor of Agricultural Engineering,
And Head of Agric. Eng. Department,
Faculty of Agriculture, Menoufiya University,
Egypt.*

Dr. Ayman Hafiz Amer Essa



*Associate professor of Agricultural Engineering,
Faculty of Agriculture, Menoufiya University,
Egypt.*

APPROVAL CERTIFICATE

Title of thesis

**EFFECT OF VIBRATIONS AND HANDLING ON PROPERTIES OF
SOME AGRICULTURAL PRODUCTS.**

Submitted to

**Department of Agricultural Engineering, Faculty of Agriculture,
Menoufiya University, Shibin El-Kom, Egypt.**

Presented by

Mostafa Mohamed Ali Azam

B.Sc. in Agricultural Engineering, 2001.

FOR

The Degree of Master of Science.

In Agricultural Science

(AGRICULTURAL ENGINEERING)

This thesis has been Approved by:

Prof. Dr. Mubarak Mohamed Mostafa

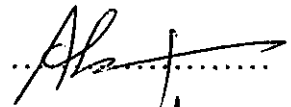
Dr. Ahamed Hassan Gomaa

Prof. Dr. Mahmoud Ali Mohamed

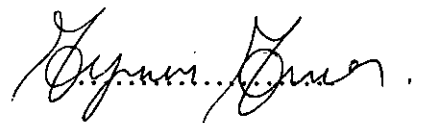
Dr. Ayman Hafiz Amer Essa

Signature









Committee in charge

Shibin El-Kom: 23/5/2007

I am especially grateful to the members of my Family *Mother, Father, all Brothers and their Wives, My wives, and My Children* “*Mohamed*” and “*Marwa*”, for their constant encouragement and moral support.

ACKNOWLEDGMENTS

First of all thanks my merciful God for his continuous help during all my life, my work and this study.

The author desires to express his full and deep thanks and his appreciation for the soul of the late ***Prof. Dr. Sayed Mohamed Sharaf***, Professor of Agricultural Engineering, for valuable suggestions, kind help, valuable guidance and encouragement.

I would also like to express my deepest thanks to ***Dr. Mahmoud Ali Mohamed***, Professor of Agricultural Engineering and head of Agricultural Engineering Department, for valuable suggestions, his encouraging spirit, continuous supervision, reading and correcting the thesis, kind assistance during the course of this work and evaluation of the manuscript.

The author desires to express his deep personal gratitude and sincere appreciation to ***Dr. Ayman Hafiz Amer Essa***, Associate professor of Agricultural Engineering Department of Agricultural Engineering, for his interest, designing the work, supervision and encouragement throughout the duration of the graduate program. I wish to thank him for his effort, during the preparation of this dissertation, reading and correcting the thesis.

I would also like to express my deepest thanks to ***Dr. Fawkia Ramadan***, Department of Production Design Eng., Faculty of Engineering, Minoufiya University, for helping me to analysis vibrations measurements.

The author expresses his thanks to ***the staff members*** of the Department of Agricultural Engineering, Minoufiya University, Shibin El-Kom, Egypt for their help and cooperation.

Mostafa Mohamed Ali Azam

CONTENTS

CONTENTS

	Page
1. INTRODUCTION.....	1
2. REVIEW OF LITERATURE.....	3
2.1. General View on Agricultural Production.....	3
2.1.1. Estimated Value of Agricultural Production.....	3
2.1.2. The Economic Status of Apple and Potato Crops.....	4
2.2. Physical Characteristics of Agricultural Materials	4
2.2.1. Size and shape	6
2.2.2. Volume and density	8
2.2.3. Specific Gravity	9
2.2.4. Sphericity.....	11
2.2.5. Surface area	12
2.3. Engineering properties	14
2.3.1. Penetration resistance.....	14
2.3.2. Firmness	14
2.3.3. Coefficient of friction	17
2.3.4. Radius of Curvature.....	20
2.4. Handling of Fruits and Vegetables	20
2.4.1. Mechanical Damage	23
2.4.1.1. Impact properties.....	24
2.4.1.2. Impact Energy.....	27
2.4.1.3. Bruising damage	28
2.5. Mechanical Vibrations	46
2.5.1. Introduction.....	46
2.6. Rheological Properties	55
2.6.1. Viscoelastic Properties	56
2.6.2. Four-elements model (Burgers' model).....	56
2.6.3. Creep Behavior	58
3. Theoretical considerations	63
3.1. Creep Theory.....	63
3.1.1. Theory of linear viscoelasticity.....	63
3.1.2. Viscoelastic behavior of Agro products.....	63
3.1.3. Modeling Agro products viscoelastic behavior	65
3.1.4. Mechanistic Modeling of Agro products.....	67
3.1.5. Formulation of Time-Dependent Mechanistic Models.....	67
3.1.6. Constitutive Behavior of the Burger Model.....	68
3.1.7. Rheological Relationships for the Burger Model.....	70

3.1.8.	Creep Compliance, D(t).....	70
4.	MATERIAL AND METHODS	71
4.1.	Materials	71
4.1.1.	Apple and Potato samples	71
4.2.	Measurements and Methods	71
4.2.1.	Physical characteristics	71
4.2.1.1.	Size and Coefficient of sperical Shape	71
4.2.1.2.	Weight and actual volume	72
4.2.1.3.	Density.....	73
	Particle density	74
4.2.1.4.	Surface area of apple and potato	74
4.2.1.5.	Moisture contant.....	75
4.2.1.6.	Specific Gravity	75
4.2.2.	Mechanical properties	75
4.2.2.1.	Coefficient of Static friction	75
4.2.2.2.	Penetration resistance and Firmness	76
4.2.2.3.	Radius of curvature	77
4.2.2.4.	Impact test and bruising damage	77
	a- free falling table.....	78
	b- the portable pendulum instrument	78
4.2.2.5.	Dynamic tests.....	79
4.2.3.	Rheological Properties	82
4.2.3.1.	Creep test	82
4.2.3.2.	Four-elements model (Burgers' model)	86
4.2.4.	Mechanical Vibrations	87
4.2.4.1.	Experimental procedure	87
4.2.4.2.	Test equipment	88
5.	RESULTS AND DISCUSSION.....	93
5.1.	Potato.....	93
5.1.1.	Physical Characteristics	93
5.1.1.1.	Linear dimensions	93
5.1.1.2.	Coefficient of spherical shape	96
5.1.1.3.	Mass of tubers	97
5.1.1.4.	Volume (measured and calculated).....	99
5.1.1.5.	Particl density	99
5.1.1.6.	Surface area	100
5.1.1.7.	Sphericity.....	101
5.1.1.8.	Specific gravity	102

5.1.2.	Engineering properties	102
5.1.2.1.	Coefficient of friction	102
5.1.2.2.	Firmness (N/mm ²).....	103
5.1.2.3.	Puncture Force, (N).....	105
5.1.2.4.	Free Impact.....	105
5.1.2.4.1	Impact height.....	105
5.1.2.4.2	Impact Energy and Bruise volume and bruising area	107
5.1.2.5.	Pendulum Impact.....	109
5.1.2.5.1	Total and absorbed energy.....	109
5.1.3.	Rheological Properties	111
5.1.3.1.	Creep test experiments	111
5.1.3.1.1	a- Instantaneous elasticity (k_1), N/mm.....	113
5.1.3.1.2	b- Retarded Elasticity (K_2), N/mm	115
5.1.3.1.3	c- Free viscous element (C_1), N.min/mm.....	117
5.1.3.1.4	d- Retarded Viscous Element (C_2), N.min/mm	118
5.1.3.2.	Fitting Burger Model to Experimental Data	120
5.1.4.	Mechanical Vibrations.....	121
5.1.4.1.	Determining the Effect of Mechanical Vibrations and Packaging Method on Damage of potato tubers.....	121
5.1.4.2.	Effect of packaging method on potato tubers bruise volume damage at different vibration frequencies.....	126
5.2.	Apple.....	128
5.2.1.	Physical Characteristics	128
5.2.1.1.	Linear dimensions	128
5.2.1.2.	Coefficient of spherical shape	131
5.2.1.3.	Mass of apples	132
5.2.1.4.	Volume (measured and calculated).....	133
5.2.1.5.	Particl density	134
5.2.1.6.	Surface area	134
5.2.1.7.	Sphericity.....	135
5.2.1.8.	Specific gravity	135
5.2.2.	Engineering properties	137
5.2.2.1.	Coefficient of friction	137
5.2.2.2.	Firmness (N/mm ²).....	137
5.2.2.3.	Puncture Force, (N).....	138
5.2.2.4.	Free Impact.....	139
5.2.2.4.1	a- Impact height.....	139
5.2.2.4.2	b- Impact Energy and Bruise volume and bruising area.....	140

5.2.2.5.	Pendulum Impact.....	143
5.2.2.5.1	Total and absorbed energy.....	143
5.2.3.	Rheological Properties	146
5.2.3.1.	Creep test experiments	146
5.2.3.1.1	a- Instantaneous elasticity (k_1), N/mm.....	147
5.2.3.1.2	b- Retarded Elasticity (K_2), N/mm	148
5.2.3.1.3	c- Free viscous element (C_1), N.min/mm.....	150
5.2.3.1.4	d- Retarded Viscous Element (C_2), N.min/mm	151
5.2.3.2.	Fitting Burger Model to Experimental Data	152
5.2.4.	Mechanical Vibrations.....	153
5.2.4.1.	Determining the Effect of Mechanical Vibrations and Packaging Method on Damage of Apples.....	153
5.2.4.2.	Effect of packaging method on Apple bruise volume damage at different vibration frequencies	158
6.	SUMMARY AND CONCLUSION.....	160
7.	REFERANCES.....	169
	Appendix.....	
	الملخص العربي	9-1

<i>No.</i>	<i>List of Tables</i>	<i>Page</i>
2-1	Static coefficients of friction for potatoes on various surfaces. Averaged for wet and dry potatoes.....	19
2-2	Factors affecting likelihood of bruising.....	31
5-1	Statistical index of some physical properties for the investigated of potato tubers	95
5-2	Distribution of the obtained data within the two main classes of fresh Apple and potato tubers coefficient of spherical Shape	97
5-3	Statistical index of some physical properties for the investigated of potato tubers.....	98
5-4	Statistical index of specific gravity for fresh Apple and potato tubers	102
5-5	Statistical index of Firmness (N/mm^2) for the investigated of Apple and potato tubers	104
5-6	Descriptive Statistics of Vibration Analysis for Potato tubers in Volume Packaging at different Frequencies	122
5-7	Descriptive Statistics of Vibration Analysis for Potato tubers in Paper Pulp Tray packaging at different Frequencies	123
5-8	Descriptive Statistics of Vibration Analysis for Potato tubers in	123