

بسم الله الرحمن الرحيم

SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

**EVALUATION OF SUGAR BEET PARAMETERS DURING
STORAGE**

By

Ebrahim Alfaig Alnoor Alfaig

B.Sc. (Honour)

Food Engineering Technology

Department of Food Science and Technology

Faculty of Science and Technology

University of Gezira

2003

Supervisors:

Main Supervisor: Dr. Kamal Suleiman Hassan

Co. Supervisor: Dr. Awad Elhag Mohammed

A

**Thesis Submitted in Partial Fulfillment of the Requirements for the
Degree of Master of Science in Food Science and Technology**

**Food Science and Technology department
College of Agricultural Studies**

2007

تقدير الجودة لبعض العوامل البنجر السكر أثناء التخزين

إعداد: إبراهيم الفائق النور الفائق
بكالريوس الشرف في تكنولوجيا هندسة الأغذية
قسم علوم وتقنولوجيا الأغذية - كلية العلوم والتكنولوجيا
جامعة الجزيرة
2003

إشراف : د. كمال سليمان حسن
المشرف المعاون : د. عوض الحاج محمد

بحث تكميلي لنيل درجة الماجستير في علوم وتقنولوجيا
الأغذية

كلية الدراسات الزراعية
قسم علوم وتقنولوجيا الأغذية

2007

Dedication

**This work is dictated
to
My family
Friends
And
Colleagues
With my love and
gratitude**

Al faig

CONTENTS

	Page No.
Acknowledgements	ii
List of Tables	iii
List of Figures	iv
Abstract	v
Abstract in Arabic	vii
CHAPTER ONE: INTRODUCTION	1
CHAPTER TWO: LITERATURE REVIEW	3
2.1 Sugar Beet	3
2.1.1 Classification of Sugar Beet	3
2.1.2 Sugar Beet Root	4
2.1.3 History of sugar beet industry	4
2.1.4 Environmental Requirements	5
2.2 Sugar beet in Sudan	6
2.3 Composition of sugar beet	8
2.3.1 The distributions of sugar beet constituents	8
2.3.2 Marc content	8
2.3.2.1 Cellulose	9
2.3.2.2 Pectic Substances	9

2.3.2.3	Hemicelluloses	11
2.3.2.4	Lignin	11
2.3.3	Composition of Cell Juice	12
2.3.3.1	Nitrogen free compounds	12
2.3.3.1.1	Monosaccharides	12
2.3.3.1.2	Oligosaccharides	12
2.3.3.1.2.1	Sucrose	13
2.3.3.1.2.1	Raffinose	13
2.3.3.1.2.2	Kestoses	13
2.3.3.1.3	Polysaccharides	13
2.3.3.1.3.1	Dextran	14
2.3.1.3.2	Levan	14
2.3.3.2	Nitrogenous compounds	14
2.3.3.2. 1	Amino acids and amides	14
2.3.3.2.2	Phenolic compounds	14
2.4	Harvesting of sugar beet	15
2.5	Beet quality after harvesting	17
2.5.1	Problems of deteriorate beet	17
2.5.2	Beet injuries	17
2.5.3	Trash and adhering soil	18
2.5.4	Defoliation and topping	21
2.5.5	Wilted beet	21
2.5.6	Fertilizer usage	21
2.6	Reception of beet	22
2.7	Determination of beet payment parameter	22
2.7.1	Weighing	22
2.7.2	Sampling	23
2.7.3	Top and soil tare determination	23
2.7.3.1	Soil tare	23
2.7.3.2	Top tare	24
2.7.4	Determination of the quality parameters	25
2.7.4.1	Sucrose	25
2.7.4.2	Determination of non- sugars	25
2.7.4.2.1	Nitrogen compounds	26
2.7.4.2.2	Alkali ions	26
2.7.4.2.3	Invert sugars	26

2.8	Beet unloading	26
2.8.1	Wet unloading	26
2.8.2	Dry unloading	27
2.9	Sugar beet storage	27
2.10	Reactions during storage	29
2.10.1	Biochemical reaction of respiration	29
2.10.2	Microbiology of beet in storage	30
2.10.2.1	Storage pathogens	30
2.10.2.2	Hot spots	31
2.11	Chemical changes in the beet composition	31
2.11.1	Sucrose losses	31
2.11.2	Soluble carbohydrates	32
2.11.2.1	Invert sugars	32
2.11.2.2	Raffinose	33
2.11.3	Soluble Noncarbohydrates	33
2.11.3.1	Nitrogen compounds	33
2.11.3.2	Nitrogen free organic acids	34
2.11.3.3	Inorganic salts	34
2.11.4	Insoluble substances, (Marc)	34
2.12	physical changes of beet in storage	35
2.12.1	Beet mass	35
2.12.2	Elasticity modulus	35
2.12.3	Permeability of beet tissue	36
2.13	Factors affecting the technological value of beet during storage	36
2.13.1	Temperature	36
2.13.2	CO_2 and O_2 contents of the surrounding air	37
2.13.3	Relative humidity	38
2.14	Storage conditions for minimal sucrose losses by respiration	38
2.14.1	Factors affecting sucrose loss	38
2.14.2	Principles of optimal sugar beet storage for low respiration losses	39
2.15	Beet storage method and conditions	40
2.15.1	Pile dimensions	40
2.15.2	Short term storage at the factory	41
2.15.2.1	Storage areas with transport facilities	41
2.15.2.2	Flat pad storage	41
2.15.3	Clamp storage (Europe)	41

2.15.4	Long term storage	42
2.15.4.1	Piling and piles	42
2.15.4.2	Ventilation	42
2.15.4.2.1	Natural ventilation	42
2.15.4.2.2	Forced air ventilation	43
	CHAPTER THREE: MATERIALS AND METHODS	
3.1	Apparatus and Reagents	44
3.1.1	Apparatus	44
3.1.2	Reagents	44
3.2	Materials and Methods	45
3.2.1	Pre-preparation of beet samples	45
3.2.1.1	Brei preparation of sugar beet (beet slices)	45
3.2.1.2	Extract preparation (wet disintegration)	46
3.3	weight loss	46
3.4	Moisture content	47
3.5	Ash content	47
3.6	Protein content	48
3.7	Determination of total soluble solids (T.S.S)	48
3.8	Determination of polarization	49
3.9	Reducing sugars	50
3.10	Pulp content of beet	51
3.11	Statistical methods	51
	CHAPTER FOUR: RESULTS AND DISCUSSION	
4.1	Approximate analysis	52
4.2	weight loss	54
4.3	Pulp%	58
4.4	Purity%	62
4.5	Reducing Sugars	67
	CHAPTER FIVE: CONCLUSIONS AND	
	RECOMMENDATIONS	
5.1	Conclusions	70
5.2	Recommendations	71
	References	72
	Appendices	78