

**EFFECT OF EDIBLE COATINGS ON POSTHARVEST
QUALITY OF GREEN BEAN (*Phaseolus vulgaris* L.)
UNDER COMMERCIAL STORAGE CONDITIONS**

By

SHEREN REDA GAMAL AHMED

B.Sc. Plant Production, Ain Shams University, 2012

A thesis Submitted in partial fulfillment

of

the requirements for the degree of

**MASTER OF SCIENCE
in**

**Agricultural Science
(Vegetable Crops)**

**Department of Horticulture
Faculty of Agriculture
Ain Shams University**

2016

Approval Sheet

EFFECT OF EDIBLE COATINGS ON POSTHARVEST QUALITY OF GREEN BEAN (*Phaseolus vulgaris* L.) UNDER COMMERCIAL STORAGE CONDITIONS

By

SHEREN REDA GAMAL AHMED

B.Sc. Plant Production, Ain Shams University, 2012

This thesis for M. Sc. degree has been approved by:

Dr. Abo El-Ezz Esa Shehata.....

Head of Research , Horticulture Research Institute, Agriculture Research
Center.

Dr. Mohamed Imam Ragab

Prof. of Vegetable Crops, Faculty of Agriculture, Ain Shams University

Dr.Ahmed Abou El-Yazied Abd El-Hafize.....

Prof. of Vegetable Crops, Faculty of Agriculture, Ain Shams University.

Date of Examination: 28 / 2 / 2016

**EFFECT OF EDIBLE COATINGS ON POSTHARVEST
QUALITY OF GREEN BEAN (*Phaseolus vulgaris* L.)
UNDER COMMERCIAL STORAGE CONDITIONS**

By

SHEREN REDA GAMAL AHMED

B.Sc. Plant Production, Ain Shams University, 2012

Under the supervision of:

Dr. Ahmed Abou El-Yazied Abd El-Hafize

Prof. of Vegetable Crops, Department of Horticulture, Faculty of
Agriculture, Ain shams University (Principal supervisor)

Dr. Hany Gamal Abd El-Gawad

Associate professor of Vegetable crops, Department of Horticulture,
Faculty of Agriculture, Ain Shams University

Dr. Hany Samir Mohamed Osman

Lecturer of Plant Physiology , Agricultural Plant Department, Faculty of
Agriculture, Ain Shams University.

ABSTRACT

SHEREN REDA GAMAL AHMED, Effect of Edible coatings on postharvest quality of green bean under commercial storage conditions. B.Sc., Department of plant production, Faculty of Agriculture, Ain Shams University, 2016.

This work was carried out at the Experimental Farm, Agriculture Faculty, Ain Shams University, Egypt during the two successive seasons of 2013 and 2014, to evaluate the effect of edible coatings on shelf life and postharvest quality of green bean (*Phaseolus vulgaris* L.) during storage. The first experiment, pods treated with edible coatings before storage at the optimum conditions (7°C, 95-98% RH). The second experiment, pods treated with edible coatings before storage at shelf life conditions (14 °C, 60-70% RH). Edible coating treatments: control, chitosan (1%), casein (2%), ascorbic acid (1%), citric acid (3%) and sucrose (1%) starch (1%) salicylic acid (2mM/l) CaCl₂ (1%). Results of this study indicated that in the first experiment, the visual quality were decreased by extending the storage period, regardless of the studied edible coatings and the best visual quality was for CaCl₂ (1%), Starch (1%), Sucrose (1%) and Salicylic acid (2mM/l) coatings. Pitting in green bean pods till the middle of storage period during first and second season, pitting was appeared at the last of storage period, where the best coatings were CaCl₂ (1%) and sucrose (1%) there is no pitting appeared. Decay of green bean was increased by extending the storage period. Citric acid (3%), chitosan (1%), casein (2%), were the most susceptible for decay during storage since they recorded the highest value of decay compared with the other coatings. Hardness were decreased by extending the storage period, the decreasing in hardness were in the same range for the tested nine edible coatings, whereas there is no significant difference between coatings.

Weight loss percentage increased by extending the storage period during storage at the optimum conditions of green bean. The lowest percentage of weight loss were detected in CaCl₂ (1%), starch (1%), sucrose

(1%). Total soluble solids increased in green bean coated with CaCl_2 (1%), chitosan (1%), ascorbic acid (1%) respectively stored at the optimum conditions (7°C) during storage for the first season. Coatings with Citric acid (3%) decreased TSS %, but the highest percentage of TSS were for the previous coatings during the second studied season. Chitosan (1%), ascorbic acid (1%) and casein (2%) coatings , record higher content of soluble sugars, but the lowest content recorded for ascorbic acid (1%) and starch (1%) coatings during the first storage season (2013) ,but for the second storage season, casein (2%), sucrose (1%) coatings, and control recorded higher content of soluble sugars and starch (1%), and ascorbic acid (1%) coatings, recorded lower content of soluble sugars. The highest activity of catalase enzyme recorded for ascorbic acid (1%), then salicylic acid (2mM/l) and chitosan (1%) coatings, respectively, but the other edible coatings CaCl_2 (1%), starch (1%), casein (2%), and control showed moderately activity of catalase enzyme, although the lowest activity of catalase enzyme recorded for citric acid (3%) coating. the previous results recorded under optimum conditions of storage. The best activity for peroxidase enzyme recorded for casein (2%) and chitosan (1%) control, coatings respectively, and the lowest activity recorded for citric acid (3%) coating, and for other treatments CaCl_2 (1%) ascorbic acid (1%) and salicylic acid (2mM/l) coatings and control showed moderate activity of peroxidise enzyme. The best activity for ascorbic acid oxidase enzyme was recorded for salicylic acid (2mM/l) and casein (2%) coating, and the lowest activity was recorded for CaCl_2 (1%) and chitosan (1%) and the other coatings ; control , ascorbic acid (1%) ,sucrose (1%), citric acid (3%), starch (1%) showing moderate activity of ascorbic acid oxidase enzyme.

Key words: Common bean, *Phaseolus vulgaris*, Edible coating, Physical characters, Chemical analysis, Enzyme activity, Shelf life.

ACKNOWLEDGEMENT

First and foremost, I feel always indebted to **Allah**, the most beneficent and merciful.

I wish to express my deep thanks and gratitude to **Dr. Ahmed Abou El-Yazied Abd El-Hafize**, Professor of Vegetable, Horticulture Department, Faculty of Agriculture, Ain Shams University, for his supervision, suggesting the research project, his valuable advices and guidance and reviewing the manuscript.

I would like to express my deepest gratitude and sincere appreciation to **Dr. Hany Gamal Abd El-Gawad**, Associate professor of Vegetable crops, Horticulture Department, Faculty of Agriculture, Ain Shams University, for his close supervision, continued encouragement and unlimited guidance during the progress of this study.

I would like also to express my deepest gratitude and sincere appreciation to **Dr. Hany Samir Mohamed Osman**, Lecturer of Plant Physiology, Agricultural Plant Department, Faculty of Agriculture, Ain Shams University, for his close supervision, continued encouragement and unlimited guidance during the progress of this study

Thanks are also extended to the staff members of the Department of Botany Production, Faculty of Agriculture, Ain Shams University for their encouragement and help during the course of this work.

Special thanks and appreciation to **Dr. Mohamed Abd El-Hamid**, Lecturer of Fruit production, Horticulture Dept., Faculty of Agriculture, Ain Shams University.

Very special thanks, grateful acknowledgement and appreciation to my friends **Eman Zakaria, Nesma M. Alam Al-Deen, and Manar Farouk**.

Thanks are also extended to my family, specially my parents, and my sisters.

CONTENTS

	Page
LIST OF TABLES	III
LIST OF FIGURES	VII
1. INTRODUCTION	1
2. REVIEW OF LITERATURE	4
1. Effect of edible coatings on Physical changes	4
2. Effect of edible coatings on Chemical changes	12
3. Effect of edible coatings on Enzyme Activity	18
3. MATERIALS AND METHODS	22
1. The experiment layout	22
2. The experimental treatments	23
3. Studied characteristics	23
3.1. Physical changes	24
3.2. Chemical changes	25
3.3. Enzyme activity	27
3.4. The experimental design	28
3.5. Statistical analysis	28
4. RESULTS AND DISSCUTION	29
4.1. Effect of edible coatings during storage at the optimum conditions on physical characters of green bean.	29
1.1. Physical characters	29
1. Visual quality (freshness)	29
2. Wrinkling	29
3. Pitting	34
4. Browning	34
5. Decay Percentage %	39
6. Crispness	42
7. Hardness (Firmness)	42
8. Weight Loss Percentage %	47

	Page
9. Dry matter Percentage %	50
4.2. Effect of edible coatings during storage at the shelf-life conditions on physical characters of green bean.....	52
4.2.1. Physical characters	52
1. Visual quality (freshness)	52
2. Wrinkling	55
3. Pitting	55
4. Browning	60
5. Decay Percentage %	60
6. Crispness	66
7. Hardness (Firmness)	66
8. Weight Loss Percentage %	70
9. Dry matter Percentage %	72
4.3. Effect of edible coatings during storage at the optimum and shelf-life conditions on chemical characters analysis of green bean.....	74
4.3.1. Chemical characters.....	74
1. Total soluble solids (TSS).....	77
2. Electrical conductivity (EC).....	78
4.3.2.1. Amino acid content.....	81
4.2.3.2. Free glucose content.....	84
4.2.3.3. L-ascorbic acid content.....	86
4.2.3.4. Total soluble protein.....	89
4.2.3.5. Catalase activity.....	91
4.2.3.6. Peroxidase (POD) activity.....	94
4.2.3.7. Ascorbic acid oxidase (AAO) activity.....	96
5. SUMMARY AND CONCLUSION	98
6. REFERENCES	106
7. ARABIC SUMMARY	

LIST OF TABLES

No.		Page
1.	Effect of edible coatings during storage at the optimum condition (7°C ,95-98% RH) on Freshness of green bean in the first season (2013).....	30
2.	Effect of edible coatings during storage at the optimum conditions (7°C , 95-98% RH) on Freshness of green bean in the second season (2014).....	31
3.	Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) on wrinkling of green bean in the first season (2013).....	32
4.	Effect of edible coatings during storage at the optimum conditions (7°C , 95-98% RH) on Wrinkling of green bean in the second season (2014).....	33
5.	Effect of edible coatings during storage at the optimum conditions (7°C , 95-98% RH) on pitting of green bean in the first season (2013).....	35
6.	Effect of edible coatings during storage at the optimum conditions (7°C , 95-98% RH) on pitting of green bean in the second season (2014).....	36
7.	Effect of edible coatings during storage at the optimum conditions (7°C , 95-98% RH) on Browning% of green bean in the first season (2013).....	37
8.	Effect of edible coatings during storage at the optimum conditions (7°C , 95-98% RH) on Browning% of green bean in the second season (2014).....	38
9.	Effect of edible coatings during storage at the optimum conditions (7°C , 95-98% RH) on decay% of green bean in the first season (2013).....	40

No.		Page
10.	Effect of edible coatings during storage at the optimum conditions (7°C , 95-98% RH) on decay% of green bean in the second season (2014).....	41
11.	Effect of edible coatings and storage period during storage at the optimum conditions (7°C , 95-98% RH) on crispness of green bean in the first season (2013).....	44
12.	Effect of edible coatings during storage at the optimum condition (7°C, 95-98%RH) on crispness of green bean in the second season (2014).....	45
13.	Effect of edible coatings during storage at the optimum conditions (7°C,95-98%RH) on Hardness of green bean in the first season (2013) and the second season (2014).....	46
14.	Effect of edible coatings during storage at the optimum conditions (7°C ,95-98% RH) on weight loss % of green in the second season (2014).....	49
15.	Effect of edible coatings during storage at the optimum conditions (7°C,95-98% RH) on Dry Matter% of green bean in the first season (2013) & second season (2014).....	51
16.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Freshness of green bean in the first season (2013).....	53
17.	Effect of edible coatings during shelf life (14°C,60-70% RH) on Freshness of green bean in the second season (2014).....	54
18.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Wrinkling of green bean in the first season (2013).....	56

No.		Page
19.	Effect of edible coatings during shelf life (14°C , 60-70% RH) on in Wrinkling of green bean in the second season (2014).....	57
20.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Pitting of green bean in the first season (2013).....	58
21.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Pitting of green bean in the second season (2014).....	59
22.	Effect of edible coatings during shelf life (14°C,60-70% RH) on Browning% of green bean in the first season (2013).....	62
23.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Browning% of green bean in the second season (2014).	63
24.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Decay% of green bean in the first season (2013).....	64
25.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Decay% of green bean in the second season (2014).	65
26.	Effect of edible coatings during shelf life (14°C,60-70% RH) on crispness of green bean in the first season (2013).....	67
27.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on crispness of green bean in the second season (2014).....	68
28.	Effect of edible coatings during shelf life (14°C, 60- 70% RH) on Hardness (kg/mm) of green bean in the first season (2013) & second season (2014).	69

No.		Page
29.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Weight Loss % of green bean in the second season (2014).....	71
30.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on Dry Matter% of green bean in the first season (2013) & second season (2014).....	73
31.	Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) on T.S.S of green bean in the first season (2013) & second season (2014).....	76
32.	Effect of edible coatings during shelf life (14°C, 60-70% RH) on T.S.S of green bean in the first season (2013) & second season (2014).....	77
33.	Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) on E.C (Ms.cm ⁻¹) of green bean in the first season (2013) & second season (2014).....	79
34.	Effect of edible coatings during shelf life (14°C, 60-70% RH) E.C. (Ms.cm ⁻¹) of green bean in the first (2013) & second season (2014).....	80

LIST OF FIGURES

	Page
Figure (1) Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) and shelf life (14°C, 60-70% RH) on amino acid content of green bean in the first season (2013).....	83
Figure (2) Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) and shelf life (14°C, 60-70% RH) on glucose content of green bean in the first season (2013).....	85
Figure (3) Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) and shelf life (14°C, 60-70% RH) on ascorbic acid content of green bean in the first season (2013).....	88
Figure (4) Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) and shelf life (14°C, 60-70% RH) on protein content of green bean in the first season (2013).....	90
Figure (5) Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) and shelf life (14°C, 60-70% RH) on catalase activity of green bean in the first season (2013).....	93
Figure (6) Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) and shelf life (14°C, 60-70% RH) on peroxidase activity of green bean in the first season (2013).....	95
Figure (7) Effect of edible coatings during storage at the optimum conditions (7°C, 95-98% RH) and shelf life (14°C, 60-70% RH) on ascorbic acid oxidase activity of green bean in the first season (2013).....	97

1. INTRODUCTION

The common Snap bean or *Phaseolus vulgaris* L. is the most important food legume for direct consumption in the world and the area cultivated annually in Egypt about 78,000 acres. (**Ministry of Agriculture, 2011**). Among major food crops, it has one of the highest levels of variation in growth habit, seed characteristics (size, shape, and color), maturity, and adaptation. It also has a tremendous variability (> 40,000 varieties). It is produced in a range of crop systems and environments in regions as diverse as Latin America, Africa, the Middle East, China, Europe, the United States, and Canada. The leading bean producer and consumer is Latin America, where beans are a traditional, significant food, especially in Brazil, Mexico, the Andean Zone, Central America, and the Caribbean. In Africa beans are grown mainly for subsistence, where the Great Lakes region has the highest per capita consumption in the world. Beans are a major source of dietary protein in Kenya, Tanzania, Malawi, Uganda, and Zambia. In Asia dry beans are generally less important than other legumes, but exports are increasing from China (**Peters, 1993**), **Wortmann and Allen. (1994)**. Beans are a nearly "perfect" food. Nutritionally rich, they are also a good source of protein, folic acid, dietary fiber and complex carbohydrates. Further, when beans are part of the normal diet, the use of maize and rice proteins increases since the amino acids are complementary. Beans are also one of the best non-meat sources of iron, providing (23 %-30 %) of daily recommended levels (**Pachico, 1993**) from a single serving. Consumption of beans is high mostly because they are a relatively inexpensive food. For the poor of the world, they are a means of keeping malnutrition at bay (**WMO, 1992**). Any advances in scientific research that benefit bean yields, particularly in developing countries, help to feed the hungry and give hope for the future.

Quality loss is not only an important subject from the marketability point of view, but is also a public health concern, as the nutritional value decreases during frozen storage and distribution. The shelf life of frozen