

# ESTIMATION OF BLENDS OF CANDELILLA WAX AND PLANT EXTRACTS FOR FRUIT STORAGE

---



By:

AQSA FARZAND

ID: s2016140018

SUPERVISOR:

DR. AYESHA MOHYUDDIN

---

DEPARTMENT OF CHEMISTRY  
SCHOOL OF SCIENCE  
UNIVERSITY OF MANAGEMENT AND TECHNOLOGY,  
LAHORE, PAKISTAN  
2018

# ESTIMATION OF BLENDS OF CANDELILLA WAX AND PLANT EXTRACTS FOR FRUIT STORAGE

Submitted to University of Management and Technology Lahore

In partial fulfillment of the requirements

For the award of degree of

**MS  
IN  
CHEMISTRY**

**BY  
AQSA FARZAND**

**ID**

s	2	0	1	6	1	4	0	0	1	8
---	---	---	---	---	---	---	---	---	---	---

**SESSION: 2016-2018**

**DEPARTMENT OF CHEMISTRY  
SCHOOL OF SCIENCE  
UNIVERSITY OF MANAGEMENT AND TECHNOLOGY,  
LAHORE, PAKISTAN**



---

## **RESEARCH COMPLETION CERTIFICATE**

Certified that the research work contained in this thesis titled, “**Estimation of blends of Candelilla wax and plant extracts for fruit storage**” has been carried out and completed by Aqsa Farzand, **ID: s2016140018**. The quantum and the quality of the work contained in this is adequate for the award of Degree of MS.

---

**Supervisor**

**Dr Ayesha Mohy-Ud-Din**  
**Associate Professor**  
Department of Chemistry,  
UMT, Lahore.

---

**External Examiner**

---

**Chairperson**

**Dr Ayesha Mohy-Ud-Din**  
**Associate Professor**  
Department of Chemistry,  
UMT, Lahore.

---

**Dean**

**Dr Muhammad Azhar Iqbal**  
**Professor**  
School of Science,  
UMT, Lahore.

---

## **DECLARATION**

I, **Aqsa Farzand** D/O **Farzand Ali** ID: **s2016140018** Session **2016-2018**

hereby declare that the matter printed in the thesis titled “**Estimation of blends of Candelilla wax and plant extracts for fruit storage**” is my own work and has not been printed, published and submitted as research work, thesis or publication in any form in any University, Research institution etc. in Pakistan or Abroad.

*Dated:* \_\_\_\_\_

\_\_\_\_\_  
*(Aqsa Farzand)*

## **DEDICATION**

Dedicated to my loving **Parents** and **Teachers**,  
Without their knowledge, wisdom, and  
Guidance, I would not have met the goals  
I have to strive and be the best to  
Reach my dreams!

---

# CONTENTS

List of Tables	viii
List of Figures & Graph	x
Acknowledgements	xi
Abstract	xii
<b>CHAPTER 1: INTRODUCTION</b>	<b>1-16</b>
1.1 . Importance of plant	1
1.2. Family Amaranthaceae	2
1.2.1. Morphology of family Amaranthaceae	2
1.2.2 Clsification of family Amaranthaceae	2
1.2.3. Economic importance of family Amaranthaceae	2
1.2.4. Medicinal values of family Amaranthaceae	3
1.3. Genus <i>Achyranthes</i>	3
1.3.1. Morphological Aspects of Genus <i>Cassia</i>	3
1.3.2. Species of Genus <i>Achyranthes</i>	3
1.4. <i>Achyranthes aspera</i> L.	4
1.4.1. Synonoms	4
1.4.2. Taxonomical Classification	4
1.4.3. Morphology of <i>A. aspera</i>	5
1.4.4. Uses of <i>A. aspera</i>	6
1.4.5. Medicinal values of <i>A. aspera</i> plant	6
1.5. Family Fabaceae	7
1.5.1. Morphology of family Fabaceae	7
1.5.2 Classification of family Fabaceae	8
1.5.2. Important genera of family Fabaceae	8
1.5.3. Economic importance of family Fabaceae	9
1.5.4. Medicinal values of family Fabaceae	9
1.6. Genus <i>Cassia</i>	9
1.6.1. Morphological Aspects of Genus <i>Cassia</i>	10
1.6.2. Species of Genus <i>Cassia</i>	10
Estimation of blends of Candelilla wax and plant extracts for fruit storage	iv

---

---

1.7. <i>Cassia fistula</i> Linn	10
1.7.1. Synonyms	11
1.7.2. Taxonomical Classification	11
1.7.3. Distribution of the Plant	11
1.7.4. Morphological Aspects of <i>C. fistula</i>	12
1.7.5. Uses of <i>C. fistula</i>	13
1.7.6. Medicinal values of <i>C. fistula</i>	13
1.8. Soxhlet Extraction	14
1.8.1. Working	14
1.9. Candelilla wax	15
1.10. Parameters	16
1.10.1. Weight	16
1.10.2. pH	16
1.10.3. Skin appearance	16
1.11. Aims & Objectives	15
<b>CHAPTER 2: LITERATURE REVIEW</b>	<b>17-28</b>
<b>CHAPTER 3: MATERIALS AND METHODS</b>	<b>29-37</b>
3.1. Apparatus/Glassware	29
3.2. Chemicals and reagent	30
3.3. Equipment/Instruments	31
3.4. Sample Collection and Plant Identification	32
3.5. General Methods of Extraction	32
3.5.1. Extraction with Methanol	32
3.5.2. Filtration and Condensation of Solvent	33
3.5.3. Extraction with Water	33
3.6. Phytochemical Analysis of plants extract	33
3.6.1. Test for the Identification of Flavonoids	33
3.6.2. Test for the Identification of Saponins	33
3.6.3. Test for the Identification of Tannins	34
3.6.4. Test for the Identification of Coumarins	34
3.6.5. Test for the Identification of Alkaloids	34
3.6.5. Test for the Identification of Steroids	34
3.7. Candelilla wax Coating	35

---

---

3.7.1. Material	35
3.6.2. Formulation	35
3.6.3. Coating on Fruits	36
3.6.4. Analysis of Fruit Coating	36
3.7. Parameters	36
3.7.1. Weight	36
3.7.2. pH	37
3.7.3. Skin appearance	37

## **CHAPTER 4: RESULTS AND DISCUSSIONS** **38-75**

4.1. Extraction of Plant Material	38
4.2. Phytochemical Analysis of plants	38
4.3. Coating of Fruit with Candelilla wax	41
4.4. Parameters to Investigate the Application of Candelilla wax in Fruits	41
4.4.1. Effect of Antioxidant Candelilla wax on weight loss in Apple: ECAA	41
4.4.2. Effect of Antioxidant Candelilla wax on weight loss in Banana: ECAA	42
4.4.3. Effect of Antioxidant Candelilla wax on weight loss in Lemon: ECAA	43
4.4.4. Effect of Antioxidant Candelilla wax on weight loss in Apple: ECCF	45
4.4.5. Effect of Antioxidant Candelilla wax on weight loss in banana: ECCF	46
4.4.6. Effect of Antioxidant Candelilla wax on weight loss in Lemon: ECCF	47
4.4.7. Effect of Antioxidant Candelilla wax on weight loss in Apple: ECC	48
4.4.8. Effect of Antioxidant Candelilla wax on weight loss in Banana: ECC	49
4.4.9. Effect of Antioxidant Candelilla wax on weight loss in Lemon: ECC	50
4.4.10. Effect of Negative control on weight loss in Apple: WOC	51
4.4.11. Effect of Negative control on weight loss in Banana: WOC	52
4.4.12. Effect of Negative control on weight loss in Lemon: WOC	53
4.4.13. Comparison of edible coating in weight loss of Apple	54
4.4.14. Comparison of edible coating in weight loss of banana	55
4.4.15. Comparison of edible coating in weight loss of Lemon	56
4.4.16. Effect of Antioxidant Candelilla wax on pH of Apple: ECAA	57
4.4.17. Effect of Antioxidant Candelilla wax on pH of Banana: ECAA	58
4.4.18. Effect of Antioxidant Candelilla wax on pH of Lemon: ECAA	59
4.4.19. Effect of Antioxidant Candelilla wax on pH of Apple: ECCF	60
4.4.20. Effect of Antioxidant Candelilla wax on pH of Banana: ECCF	61

---

4.4.21. Effect of Antioxidant Candelilla wax on pH of Lemon: ECCF	62
4.4.22. Effect of Antioxidant Candelilla wax on pH of Apple: ECC	63
4.4.23. Effect of Antioxidant Candelilla wax on pH of Banana: ECC	64
4.4.24. Effect of Antioxidant Candelilla wax on pH of Lemon: ECC	65
4.4.25. Effect of Negative control in pH of Apple: WOC	66
4.4.26. Effect of Negative control in pH of Banana: WOC	67
4.4.27. Effect of Negative control in pH of Lemon: WOC	68
4.4.28. Comparison of edible coating in pH of Apple	69
4.4.29. Comparison of edible coating in pH of Banana	70
4.4.30. Comparison of edible coating in pH of Lemon	71
4.4.31. Effect of Candelilla wax on skin Appearance of Apple	72
4.4.32. Effect of Candelilla wax on skin Appearance of Banana	73
4.4.33. Effect of Candelilla wax on skin Appearance of Lemon	74
<b>REFERENCES</b>	<b>75-87</b>

---

## **LIST OF TABLES**

Table 3.1: List of Apparatus/Glassware	29
Table 3.2: List of Chemicals	30
Table 3.3: List of Equipment	31
Table 4.1: Phytochemical Analysis Results of the Extracts of <i>A. aspera</i>	39
Table 4.2: Phytochemical Analysis Results of the Extracts of <i>C. fistula</i>	40
Table 4.3: Weight Loss Activity in Apple: ECAA film	42
Table 4.4: Weight Loss Activity in Banana: ECAA film	43
Table 4.5: Weight Loss Activity in Lemon: ECAA film	44
Table 4.6: Weight Loss Activity in Apple: ECCF film	45
Table 4.7: Weight Loss Activity in Banana: ECCF film	46
Table 4.8: Weight Loss Activity in Lemon: ECCF film	47
Table 4.9: Weight Loss Activity in Apple: ECC film	48
Table 4.10: Weight Loss Activity in Banana: ECC film	49
Table 4.11: Weight Loss Activity in Lemon: ECC film	50
Table 4.12: Weight Loss Activity in Apple: WOC	51
Table 4.13: Weight Loss Activity in Banana: WOC	52
Table 4.14: Weight Loss Activity in Lemon: WOC	53
Table 4.15: Comparison of Weight loss in Apple	54
Table 4.16: Comparison of Weight loss in Banana	55
Table 4.17: Comparison of Weight loss in Lemon	56
Table 4.18: Effect of pH in Apple: ECAA film	57
Table 4.19: Effect of pH in Banana: ECAA film	58
Table 4.20: Effect of pH in Lemon: ECAA film	59
Table 4.21: Effect of pH in Apple: ECCF film	60
Table 4.22: Effect of pH in Banana: ECCF film	61
Table 4.23: Effect of pH in Lemon: ECCF film	62
Table 4.24: Effect of pH in Apple: ECC film	63
Table 4.25: Effect of pH in Banana: ECC film	64

---

Table 4.26: Effect of pH in Lemon: ECC film	65
Table 4.27: Effect of pH in Apple: WOC film	66
Table 4.28: Effect of pH in Banana: WOC film	67
Table 4.29: Effect of pH in Lemon: WOC film	68
Table 4.30: Comparison of PH on Apple	69
Table 4.31: Comparison of PH on Banana	70
Table 4.32: Comparison of PH on Lemon	71
Table 4.33: Effect of Candelilla wax on Appearance of Apple	72
Table 4.34: Effect of Candelilla wax on Appearance of Banana	73
Table 4.35: Effect of Candelilla wax on Appearance of Lemon	74

---

## **LIST OF FIGURES**

Fig 1.1: Plant of <i>A. aspera</i> L	5
Fig 1.2: Flower of <i>A. aspera</i>	5
Fig 1.3: Seeds of <i>A. aspera</i>	5
Fig 1.4: Flowers of <i>C. fistula</i>	12
Fig 1.5: Pods and leaves of <i>C. fistula</i>	12
Fig4.1.Effect of <i>A. aspera</i> plant extract on weight loss of Apple: ECCA film	42
Fig 4.2 Effect of <i>A. aspera</i> plant extract on weight loss of banana: ECCA film	43
Fig 4.3 Effect of <i>A. aspera</i> plant extract on weight loss of lemon: ECCA film	44
Fig 4.4 Effect of <i>C. fistula</i> plant extract on weight loss of apple: ECCF film	45
Fig 4.5 Effect of <i>C. fistula</i> plant extract on weight loss of Banana: ECCF film	46
Fig 4.6 Effect of <i>C. fistula</i> plant extract on weight loss of Lemon: ECCF film	47
Fig 4.7 Effect of Candelilla wax on weight loss: ECC film	48
Fig 4.8 Effect of Candelilla wax on weight loss: ECC film	49
Fig 4.9 Effect of Candelilla wax on weight loss: ECC film	50
Fig 4.10 Effect of WOC on weight loss activity in Apple	51
Fig 4.11 Effect of WOC on weight loss activity in Banana	52
Fig 4.12 Effect of WOC on weight loss activity in Lemon	53
Fig 4.13 Effect of antioxidant Candelilla wax on weight loss in Apple	54
Fig 4.14 Effect of antioxidant Candelilla wax on weight loss in Banana	55
Fig 4.15 Effect of antioxidant Candelilla wax on weight loss in Lemon	56
Fig 4.16 Effect of <i>A. aspera</i> plant extract on pH of Apple: ECAA film	57
Fig 4.17 Effect of <i>A. aspera</i> plant extract on pH of Banana: ECAA film	58
Fig 4.18 Effect of <i>A. aspera</i> plant extract on pH of Lemon: ECAA film	59
Fig 4.19 Effect of <i>C. fistula</i> plant extract on pH of Apple: ECCF film	60
Fig 4.20 Effect of <i>C. fistula</i> plant extract on pH of Banana: ECCF film	61
Fig 4.21 Effect of <i>C. fistula</i> plant extract on pH of Lemon: ECCF film	62
Fig 4.22 Effect of Candelilla Wax on pH: ECC film	63
Fig 4.23 Effect of Candelilla Wax on pH of banana: ECC film	64
Fig 4.24 Effect of Candelilla Wax on pH of Lemon: ECC film	65

---

Fig 4.25 Effect of WOC on pH of banana	66
Fig 4.26 Effect of WOC on pH of banana	67
Fig 4.27 Effect of WOC on pH of lemon	68
Fig 4.28 Variation in pH due to edible coating in Apple	69
Fig 4.29 Variation in pH due to edible coating in Banana	70
Fig 4.30 Variation in pH due to edible coating in Lemon	71

---

## **ACKNOWLEDGEMENTS**

Firstly, I am thankful to **Allah Almighty** for giving me strength and courage at each and every step in accomplishment of this thesis. Countless salutations are upon the **Holy Prophet** (Peace be upon him) who enabled me to recognize my Creator and declared it to be an obligatory duty of every Muslim to acquire knowledge.

I would like to honor the special regards to **Dr. Muhammad Azhar Iqbal** Dean of school of Science UMT, who takes special interest in research activities. I feel great great pleasure in bringing on my deep sense of gratitude for help and cooperation in providing the facilities throughout the research period.

I am most thankful to my supervisor and my inspiration **Dr. Ayesha Mohyuddin** not only for providing me opportunity to do my research work but also for her dynamic elaborate instructions, enlightening suggestions, illustrious advices, and persistent help and clarifying my concepts relating to course work and guiding me at each and every step of this research work. Her help of constructive comments and suggestions throughout the experimental and thesis work have contributed to the success of this research.

It is fact that I would not be successful in my aim without sincerest prayers and guidance of **Muhammad Hashim**. All of his prayed for my brilliant success and provided me every facilities and cooperation during my academic career with tremendous love and honor.

**Aqsa Farzand**

---

## **ABSTRACT**

Now a days there is high demand for healthier and fresh food consumption by society. In recent years, naturally occurring substances have been mainly focused to process fruits and vegetable being as alternative antioxidants and antimicrobials. Blending of plant extracts of medicinal plants with Candelilla wax used for edible coating has been experimented by different researchers. In this study two medicinal plants are selected who are known to have antifungal potential. *Cassia Fistula* commonly known as Amaltash phal is one of most versatile medicinal plant of Fabaceae family which have great attraction for scholars. Studies showed the presence of antifungal activity present in leaves extracts. Its active components have reported pharmacological effects like antimicrobial, antioxidant, anti-inflammatory, hepaprotective and hypoglycemic potential. The powdered leaves of *C. fistula* were extracted in Soxhlet extractor with methanol. *Achyranthes aspera* belongs to the Amaranthaceae family. The plant are used to cure antirhematic, diuretic, dental pain or menstrual discomfort. Studies reveals that antifungal properties are depicted in plant leaves extracts. The well known ingredients which were isolated from this plant are flavones derivatives (astragalin, isoquercetin), phenolic acids, sterols, quinones, polysaccharides, saponins. The powdered leaves of *A. aspera* and *C. fistula* were extracted with methanol. This study will be useful to explore the application of blended wax to prolong the freshness of fruit on industrial scale. In this study, Films formulated with edible natural wax, and additives *A. aspera* and *C. fistula* were applied to evaluate their effects on the quality of fruits. Weight loss activity was performed against all samples. ECAA and ECCF showed a lowest weight loss as compared to ECC and WOC. In ECAA film there was less weight loss started from 0.3g to 1.5g after 150h in apples. In ECCF, 0.2g to 1.2g weight loss was found after 150 in apples, but on the other hand weight loss activity in ECC 0.3 to 3.0 and WOC 0.4 to 1.8 after 150h, that was higher as compared to ECAA and ECCF. ECAA and ECCF showed good result in apples but in bananas and lemons, due to sensitivity of fruits it's showed higher weight and pH loss.

**CHAPTER 1**  
**INTRODUCTION**

## **1.1 IMPORTANCE OF PLANT**

From thousands of years, nature has been a source of natural products and many of these are isolated from medicinal plants. In medicinal plants, there are a numbers of phytochemical compounds, which are not only helpful in the functioning of body but also help in fighting against diseases. Traditional medicinal plant produce a wide range of bioactive compounds or molecules that are help in the treatment of different diseases. Today most of the drugs are obtained from natural products or semi synthetic natural products (Sukanya *et al*, 2009). 20% of the plants has been uses in the pharmaceutical industry to attain a wide range of antibiotics that are obtained from natural or synthetic drugs (Mothana *et al*, 2005).