

634.772

V66

2005

POSTHARVEST CHARACTERIZATION AND SENSORY  
EVALUATION OF THE INTRODUCED FHIA AND  
LOCAL SABA VARIETIES OF BANANA

EDNA A. VIDA

APRIL 2009

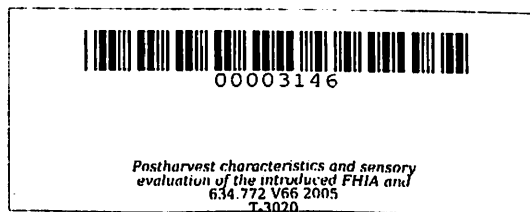


**POSTHARVEST CHARACTERISTICS AND SENSORY EVALUATION  
OF THE INTRODUCED FHIA AND LOCAL  
SABA VARIETIES OF BANANA**

**EDNA A. VIDA**

**SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL,  
CAVITE STATE UNIVERSITY, INDANG, CAVITE  
IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF**

**DOCTOR OF PHILOSOPHY  
(Crop Science)**



**April 2005**

## **ABSTRACT**

**VIDA, EDNA DELAS ALAS, Postharvest Characterization and Sensory Evaluation of the Introduced FHIA and Local Saba Varieties of Banana. Ph. D. Dissertation. Doctor of Philosophy in Crop Science, major in Horticulture. Cavite State University, Indang, Cavite. April 2005. Adviser: Dr. Arnulfo C. Pascual.**

The morphological, physico-chemical and physiological characteristics of the introduced FHIA varieties from Honduras was compared to the local Saba variety at harvest and during ripening. All the banana varieties were considered for cooking purposes. The varieties showed similarities and differences in all aspects of characterization. Of the three varieties that were compared to Saba, the FHIA 3 manifested the best resemblance to the Saba variety. The former variety showed similarities in terms of bunch description, angular fruit, blunt-tipped apex, pattern in respiration and ethylene production. Although the panelists have already developed the taste for the local Saba, both as boiled and unboiled, the general acceptability for FHIA 3 did not differ significantly. Saba was superior to all varieties in terms of fruit weight, fruit girth, fruit volume and pulp thickness, making it the firmest. FHIA 3 had the thickest peel. FHIA 23 had the heaviest bunch which could be attributed to the considerable number of hands and number of fingers per hand. The pulp moisture content was highest with FHIA 23 during the harvest and ripe stages. Conversely, the highest dry matter content was seen in FHIA 21 at both stages. The peel color changed from

green to yellow in all varieties. However, it took only five days to ripen for the FHIA 23, seven days for Saba and FHIA 21 and nine days for the FHIA 3. The very thick peel of the FHIA 3 contributed to the delay in the ripening. The titratable acidity of the FHIA 3 was highest after harvest, but this trend shifted to the FHIA 23 at the ripe stage. There was no traceable amount of total soluble solids when all the bananas were still green, subsequently becoming highest in the FHIA 3 after ripening. The starch index pattern, indicating starch content, was most pronounced in the Saba and FHIA 21. The climacteric rise in respiration was fastest with FHIA 23, which was paralleled by the sudden upsurge in ethylene production. With regards to the best varieties for banana chips and catsup production, it was remarkable to note that FHIA 21 was more preferred than the Saba. The hard quality of the chips from the Saba made it inferior to FHIA 21. Corresponding to this is the results obtained from the sensory evaluation of banana catsup. The product made from FHIA 23 was most preferred, due to its good mouthfeel, taste, as well as for exhibiting darkest red color. It was also note that the FHIA 23 catsup had thick consistency.

## **TABLE OF CONTENTS**

	<b>Page</b>
<b>BIOGRAPHICAL SKETCH</b>	<b>iii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iv</b>
<b>LIST OF TABLES</b>	<b>xii</b>
<b>LIST OF FIGURES</b>	<b>xiii</b>
<b>LIST OF APPENDICES</b>	<b>xv</b>
<b>ABSTRACT</b>	<b>xvi</b>
<b>INTRODUCTION</b>	<b>1</b>
Importance of the Study	3
Scope and Limitation of the Study	5
Objectives	5
Time and Place of the Study	6
<b>REVIEW OF RELATED LITERATURES</b>	<b>7</b>
Importance of Banana	7
Varieties of Banana	8
Problems with pests and diseases	9
History of FHIA	11
Postharvest Characteristics	14
Peel and pulp color	14
Pulp firmness	15

Total soluble solids	15
Total titratable acidity	15
Peel and pulp moisture and dry matter content	16
Fruit Ripening Quality	16
Peel color change	17
Starch conversion into sugar	19
Change in pulp to peel ratio	20
Change in pulp firmness	20
Change in total soluble solids content	21
Change in pulp pH and total titratable acidity	21
Change in peel and pulp moisture and dry matter content.	22
Change in respiration rate and ethylene production	22
Sensory Evaluation	23
Banana chips (Crisps)	25
Banana sauce (Catsup)	25
METHODOLOGY	27
Harvesting of Banana	27
Experiment I. Bunch and fruit characterization of the introduced FHIA and local <i>Saba</i> banana varieties at harvest	27
Bunch weight	28
Bunch shape and appearance	28
Number of hands	28
Number of fingers per hand	28

Fruit color	28
Fruit shape	29
Fruit apex	30
Transverse section of the fruit	31
Fruit weight	31
Fruit length	31
Fruit girth or circumference	32
Fruit volume	32
Pulp and peel thickness	32
Pulp and peel weight	33
Pulp to peel ratio	33
Pulp moisture and dry matter content	33
<b>Experiment II. Physico-chemical and physiological studies on ripening of introduced FHIA and local <i>Saba</i> varieties of banana</b>	<b>34</b>
Peel and pulp color	34
Pulp firmness	34
Titratable acidity	34
Total soluble solids	35
Number of days to full yellow stage	36
Changes during ripening	36
Change in peel color	36
Change in starch index pattern	37
Change in pulp to peel ratio	37

Change in respiration rate and ethylene production	37
Statistical Analysis	42
Experiment III. Sensory evaluation on ripe and processed fruits using introduced FHIA and local <i>Saba</i> varieties of banana	42
Boiling of ripe banana	42
Processing into banana chips	42
Processing into banana catsup	43
Sensory evaluation	44
Statistical Analysis	44
RESULTS AND DISCUSSION	45
Experiment I. Bunch and fruit characterization of the introduced FHIA and local <i>Saba</i> banana varieties at harvest	45
Experiment II. Physico-chemical and physiological studies on ripening of introduced FHIA and local <i>Saba</i> varieties of banana	54
Peel and pulp color	54
Firmness	55
Titratable acidity	56
Total soluble solids	57
Pulp dry matter and moisture content	57
Physical change	58
Number of days to Color Index 6	58
Pulp and peel color changes	59
Starch index pattern	63



Change in pulp to peel ratio	64
Physiological changes during ripening	65
Respiration rate	65
Ethylene production	66
Experiment III. Sensory evaluation on ripe and processed fruits using introduced FHIA and local <i>Saba</i> varieties of banana	69
Sensory properties of ripe banana	69
Texture	69
Taste	70
Sweetness	70
General acceptability	70
Sensory properties of ripe boiled banana	72
Texture	72
Taste	72
Sweetness	72
General acceptability	73
Sensory properties of banana chips	74
Color	74
Sweetness	74
Crispness	74
General acceptability	75
Sensory properties of banana catsup	76
Mouthfeel	77

Taste	77
Color	77
Sweetness	78
General acceptability	78
SUMMARY AND CONCLUSION	81
RECOMMENDATION	86
LITERATURE CITED	88
APPENDICES	94

## **TABLE OF CONTENTS**

	<b>Page</b>
<b>BIOGRAPHICAL SKETCH</b>	<b>iii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iv</b>
<b>LIST OF TABLES</b>	<b>xii</b>
<b>LIST OF FIGURES</b>	<b>xiii</b>
<b>LIST OF APPENDICES</b>	<b>xv</b>
<b>ABSTRACT</b>	<b>xvi</b>
<b>INTRODUCTION</b>	<b>1</b>
Importance of the Study	3
Scope and Limitation of the Study	5
Objectives	5
Time and Place of the Study	6
<b>REVIEW OF RELATED LITERATURES</b>	<b>7</b>
Importance of Banana	7
Varieties of Banana	8
Problems with pests and diseases	9
History of FHIA	11
Postharvest Characteristics	14
Peel and pulp color	14
Pulp firmness	15

Total soluble solids	15
Total titratable acidity	15
Peel and pulp moisture and dry matter content	16
Fruit Ripening Quality	16
Peel color change	17
Starch conversion into sugar	19
Change in pulp to peel ratio	20
Change in pulp firmness	20
Change in total soluble solids content	21
Change in pulp pH and total titratable acidity	21
Change in peel and pulp moisture and dry matter content.	22
Change in respiration rate and ethylene production	22
Sensory Evaluation	23
Banana chips (Crisps)	25
Banana sauce (Catsup)	25
METHODOLOGY	27
Harvesting of Banana	27
Experiment I. Bunch and fruit characterization of the introduced FHIA and local <i>Saba</i> banana varieties at harvest	27
Bunch weight	28
Bunch shape and appearance	28
Number of hands	28
Number of fingers per hand	28

Fruit color	28
Fruit shape	29
Fruit apex	30
Transverse section of the fruit	31
Fruit weight	31
Fruit length	31
Fruit girth or circumference	32
Fruit volume	32
Pulp and peel thickness	32
Pulp and peel weight	33
Pulp to peel ratio	33
Pulp moisture and dry matter content	33
<b>Experiment II. Physico-chemical and physiological studies on ripening of introduced FHIA and local <i>Saba</i> varieties of banana</b>	<b>34</b>
Peel and pulp color	34
Pulp firmness	34
Titratable acidity	34
Total soluble solids	35
Number of days to full yellow stage	36
Changes during ripening	36
Change in peel color	36
Change in starch index pattern	37
Change in pulp to peel ratio	37



Change in respiration rate and ethylene production	37
Statistical Analysis	42
Experiment III. Sensory evaluation on ripe and processed fruits using introduced FHIA and local <i>Saba</i> varieties of banana	42
Boiling of ripe banana	42
Processing into banana chips	42
Processing into banana catsup	43
Sensory evaluation	44
Statistical Analysis	44
RESULTS AND DISCUSSION	45
Experiment I. Bunch and fruit characterization of the introduced FHIA and local <i>Saba</i> banana varieties at harvest	45
Experiment II. Physico-chemical and physiological studies on ripening of introduced FHIA and local <i>Saba</i> varieties of banana	54
Peel and pulp color	54
Firmness	55
Titratable acidity	56
Total soluble solids	57
Pulp dry matter and moisture content	57
Physical change	58
Number of days to Color Index 6	58
Pulp and peel color changes	59
Starch index pattern	63

Change in pulp to peel ratio	64
Physiological changes during ripening	65
Respiration rate	65
Ethylene production	66
Experiment III. Sensory evaluation on ripe and processed fruits using introduced FHIA and local <i>Saba</i> varieties of banana	69
Sensory properties of ripe banana	69
Texture	69
Taste	70
Sweetness	70
General acceptability	70
Sensory properties of ripe boiled banana	72
Texture	72
Taste	72
Sweetness	72
General acceptability	73
Sensory properties of banana chips	74
Color	74
Sweetness	74
Crispness	74
General acceptability	75
Sensory properties of banana catsup	76
Mouthfeel	77

Taste	77
Color	77
Sweetness	78
General acceptability	78
SUMMARY AND CONCLUSION	81
RECOMMENDATION	86
LITERATURE CITED	88
APPENDICES	94

## **LIST OF TABLES**

<b>Table</b>		<b>Page</b>
<b>1</b>	<b>Bunch and fruit characteristics of the different banana varieties at harvest</b>	<b>48</b>
<b>2</b>	<b>Physico-chemical properties of the different banana varieties at harvest and at full-yellow stage</b>	<b>55</b>
<b>3</b>	<b>Mean scores for sensory evaluation of the different banana varieties at their ripe stage</b>	<b>71</b>
<b>4</b>	<b>Mean scores for sensory evaluation of ripe boiled banana of the different varieties</b>	<b>73</b>
<b>5</b>	<b>Mean scores for sensory evaluation of banana chips using the different banana varieties</b>	<b>76</b>
<b>6</b>	<b>Mean scores for sensory evaluation of catsup using the different banana varieties</b>	<b>79</b>

## **LIST OF FIGURES**

<b>Figure</b>	<b>Page</b>
1    Banana color stage chart (CSIRO)	18
2    Fruit shape	29
3    Fruit apex	30
4    Transverse section of fruit	31
5    Static set up for respiration and ethylene evolution measurement	39
6    Shimadzu gas chromatograph equipped with thermal conductivity detector for measuring carbon dioxide and oxygen levels	40
7    Shimadzu gas chromatograph equipped with thermal conductivity detector for measuring ethylene levels	41
8    Typical bunches of the different varieties of banana	49
9    Typical hands of the different varieties of banana	50
10   Typical fingers of the different varieties of banana	51
11   Typical fruit apices of the different varieties of banana	52
12   Transverse sections of fruits of the different varieties of banana	53
13   Number of days to full yellow stage of the different varieties of banana	59
14   Peel color development of the different varieties of banana	60
15   Peel color changes of the different varieties of banana during ripening	61
16   Pulp color changes of the different varieties of banana	



## LIST OF APPENDICES

Appendix		Page
A	Score sheet for sensory evaluation of banana	95
B	Score sheet for sensory evaluation of banana chips	96
C	Score sheet for sensory evaluation of banana catsup	97
D	General information on the varietal characteristics of <i>Saba</i>	98
E	General information on the varietal characteristics of FHIA 3	100
F	General information on the varietal characteristics of FHIA 21	102
G	General information on the varietal characteristics of FHIA 23	104

## INTRODUCTION

Banana (*Musa spp*) is considered as the most important fruit crop in the country in terms of volume of production and export earnings. In 2003, the Philippines exported 1,829,000 MT, with a total value of US\$333 million Fresh on Board (Statistical Yearbook, 2003). In fact, it ranked 5<sup>th</sup> in global production in CY 2002 with India, Ecuador, Brazil and China on the top of the list (Faylon *et al.* 2003). The Philippines is the only Southeast Asian country that made it to the top five major suppliers of banana in the world. From the country's total banana production (1991 to 2001), 50 percent are consumed as fresh, 35 percent are processed for food and 15 percent for waste (Eusebio *et al.* 2002).

Banana production is a source of income and employment in the countryside with more than 5.6 million smallholder farmers dependent on it (Calderon, 2000). About 80-90 percent of the total hectareage are cultivated by small growers using *Lakatan*, *Latundan* and *Saba* as a component of the farming system. The exportable cultivar, Cavendish, is grown under the corporate farming scheme.

It could be noted that there exists a remarkable difference in the production, postproduction technologies and management systems between the corporate and the small hold banana farms (Faylon, 2003). The corporate production system caters to the strict requirements of the export market. The enterprise is capital-intensive and production practices are applied at optimum levels and quality and yields are high (Valmayor, 1989).