UNIVERSITY OF COPENHAGEN
FACULTY OF SCIENCE

Aroma Development and Volatile Composition in Mango

A Theoretical Report on the Biochemical Pathways, Ripening Physiology, and Quality Determinants in mango.

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Preface

This written report has been prepared as part of the course NPLK14014U - Fruit and Berry Crop Physiology and Quality at the University of Copenhagen. The course explores the physiological and biochemical factors determining fruit development, yield, and quality in relation to fresh consumption and processing. Emphasis is placed on how genetic, environmental, and management factors influence internal and external fruit quality, including the formation of secondary metabolites and sensory attributes such as aroma.

The present project is a theoretical study on the development and composition of aroma in mango, *Mangifera indica L.*, The focus is on the biochemical formation of volatile organic compounds (VOCs) and their relationship to fruit ripening and sensory quality. The report integrates physiological and biochemical knowledge to describe how preharvest conditions, cultivar differences, and post-harvest handling affect aroma expression and the perception of fruit quality.

The assignment was carried out by Lucas Daniel Paz Zuleta (TZS159), MSc student at the University of Copenhagen, as an individual written report fulfilling the course requirements for NPLK14014U - Fruit and Berry Crop Physiology and Quality.

Summary

Signatures

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1 Introduction

Fruits are complex and heterogeneous structures that comprise a wide variety of metabolites that serve as precursors to volatile organic compounds (VOCs), such as carbohydrates, fatty acids, and pigments [1]. The mango fruit is no exception of this complexity and have in recent years been the focus of many studies, studying the activity of volatiles in the fruit [2].

1.1 Background

Mango is a tropical fruit which belongs to the Anacardiaceae family and is scientifically known as *Mangifera* [2]. It is popularly characterised as a sweet, juicy, aromatic fruit with a low fibre flesh [3]. It is primarily cultivated in tropical and subtropical regions, where it is of significant economic importance [3]. The annual tropical production of mango is over 46 million tons and is thereby the most produced tropical fruit after banana [4]. The perishable nature and susceptibility to post-harvest losses and diseases pose challenges for the mango industry, restricting the production and potential [3].

1.2 Focus on Mango

The mango is an important fruit crop worldwide, valued for its high nutritional content, with significant levels of fibre, vitamin C and β-carotene [4]. However, beyond its nutritional benefits, the mango is particularly renowned for its distinctive aroma, which plays a crucial role in consumer preference and marketability [5]. s of quality and freshness [3]. A study by Badar et al. (2016) found that aroma is one of the most important quality attributes that influence consumer preference and acceptance of mango fruit [5]. The main aroma contributors in mango are the VOCs; aldehydes, alcohols, esters and ketones [6]. Among these, 3-carene, limonene, β-pinene, acetaldehyde, ethanol and hexanal [6]. Understanding the origin and behaviour of these volatiles is therefore essential for improving fruit quality, post-harvest handling, and processing applications.

1.3 Aim and Scope

The aim of this report is to explore the formation, composition, and significance of VOCs in mango fruits. The main focus is on how these compounds contribute to the fruit's aroma and overall quality, both in terms of maintaining freshness and enhancing consumer appeal. The scope includes an overview of the chemical classes and key VOCs identified in mango, the metabolic- and enzymatic pathways involved in their biosynthesis, and the influence of pre- and post-harvest conditions on their abundance. Finally, the report outlines the methods commonly applied for the extraction and identification of VOCs and their relevance for assessing fruit quality and consumer perception.

2 Aroma Composition in Mango

The complexity of aromas in mango is due to the variety of VOCs that are present in the fruit's matrix. These compounds arise from different biochemical pathways and contribute to the overall sensory experience of the fruit [3]. These pathways are most prominently manifested during the ripening processes of the fruit. Also visual and textural changes occur during ripening, which further influence the perception of aroma [3].

2.1 Chemical Classes of Mango Aroma Compounds

The volatile composition in fresh mango fruits has been extensively studied, revealing a diverse array with several hundred identified volatile compounds, occuring in free form in the fruit [4]. By calculating the flavour dilution factor (FD) of the volatile compounds using gas chromatography-olfactometry (GC-O) analysis, it has been possible to identify the key aroma compounds fir the odour-active fraction [4].
Mango aroma is primarily composed of several chemical classes. The most dominant classes is monoterpene hydrocarbons, which account for 90.2% of the total volatile compounds in fresh mango, as illustrated in Figure 1.1. Other significant classes include lactones (4.1%) and sesquiterpene hydrocarbons (3.0%) [4].

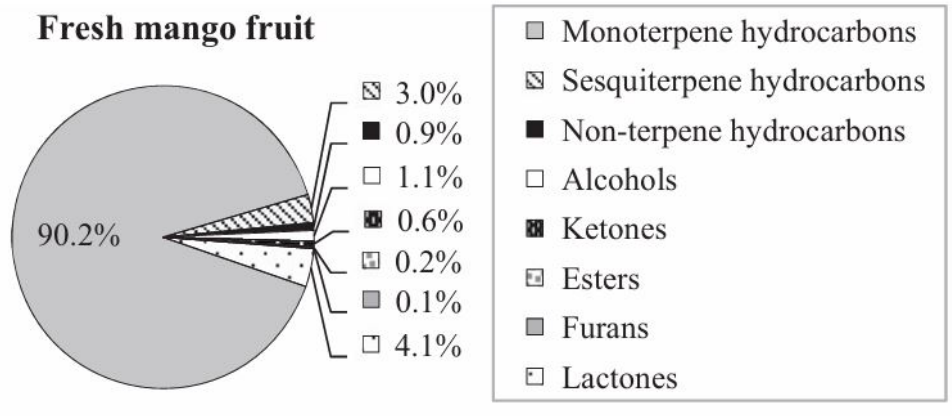

Figure 1.1: *Distribution [%] of chemical classes of volatile compounds in fresh mango. Adapted from Bonneau et al. (2016) [4].*

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