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FACTORS AFFECTING FLAVOUR AND SENSORY QUALITY OF FRUITS

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Introduction:

The sensory quality of fruits is a critical aspect when evaluating different fruit cultivars for both fresh consumption and the processing industry. For fresh consumption, key quality attributes include color, taste, flavour and texture. In the evaluation of processed foods, flavour and odour are among the most crucial quality attributes. While there are instrumental methods to assess these aspects, subjective or human evaluation techniques are often more suitable and sensitive. Two primary subjective evaluation methods are consumer acceptance tests and panel difference methods. Consumer acceptance tests are used to assess new products, changes in manufacturing procedures, reformulations, or quality comparisons with competitor's products and require a diverse group of consumers. In the panel difference method, a small group of individuals is trained to evaluate processed products by describing their attributes. Panelists are often selected based on their ability to detect different taste sensations (sour, sweet, bitter and salty) and their sensitivity to specific flavour or odour compounds. The choice of the evaluation method depends on the product, its characteristics, the target market and the specific flavour or odour components of interest. Various product difference tests exist, including paired comparison, triangle, dilution, ranking, numerical scoring, descriptive and flavour or odour difference methods. The overall sensation of flavour comprises taste and aroma, with aroma often playing a dominant role. The receptors on the tongue perceive taste, while aroma significantly contributes to the overall flavour. Some studies reported that volatile compounds significantly influence odour and flavour perception in tomatoes. Despite the identification of over 400 aroma substances in tomato fruit, only about 30 are considered important for flavour based on their odour thresholds. Another critical component of consumer perception of tomato quality is texture, encompassing attributes like firmness, mealiness, meltiness, juiciness and crispness. The sensory quality of fruit has become a pivotal factor in consumers purchasing decisions. It encompasses attributes such as

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sweetness, acidity, aroma, firmness and color. In recent years, consumers have increasingly voiced their dissatisfaction with the poor eating quality of fruit available in the market, making flavour a decisive factor in their purchasing choices. The sensory quality of fruit depends on several factors, including the fruit variety, growing conditions, harvest date and postharvest handling and storage techniques. Among these factors, the genotype or fruit variety is arguably the most critical in determining the overall sensory quality of the fruit.

PRE HARVEST CONDITIONS FOR AFFECTING FLAVOUR AND SENSORY QUALITY OF FRUITS:

The significance of preharvest conditions on the flavour quality of fruits, particularly focusing on factors that influence fruit maturity and ripening, the impact of harvesting practices and the accumulation of compounds responsible for fruit flavour.

Maturity Stage and Flavour Quality: The stage of maturity at the time of harvest plays a critical role in determining the flavour quality of fruits, second only to the genetic characteristics of the fruit variety. As fruits mature and ripen, both non-volatile and volatile compounds that contribute to flavour increase in concentration.

Early Harvest Practices: Commercially, it is common to harvest fruits before they reach their optimal maturity due to economic factors, such as higher prices early in the harvest season. Regulatory authorities often do not enforce minimum maturity indices, leading to early harvesting. Additionally, early harvest is driven by the need for firmer fruits that can withstand handling and storage.

Effect of Early Harvest: When apples are harvested before reaching the climacteric stage and stored in various conditions, they do not achieve good eating quality.

Flavour Composition: The flavour of a fruit is a complex combination of sensory responses in both the nose and mouth to odour and taste. Various compounds, including acids, sugars, volatiles and other substances, either individually or in synergy, contribute to the overall flavour of the fruit. These compounds accumulate during the growth, development, ripening and senescence of the fruit and are influenced by genetic factors as well as preharvest, harvesting and postharvest conditions.

Research Findings: Several studies have investigated the impact of harvest timing and storage conditions on the volatile compounds responsible for fruit aroma. For example, a study on Fuji apples found that certain aroma compounds reached their peak concentration after a specific storage duration

and ripening period. The conditions and season can significantly affect the aroma of fruits.

Optimum Harvest Time: The timing of harvest can influence the sweetness, sourness and aroma compounds during cold storage, as observed in the case of red delicious apples. The maturity at harvest affects how long it takes for aroma volatiles to reach an optimal level after removal from controlled atmosphere storage.

Variety-Specific Findings: Different varieties of fruits may exhibit variations in the production of aroma volatiles and other flavour-related compounds based on their harvest maturity. For example, Pink Lady apples acceptability was positively influenced by specific compounds during cold storage, while the production of aroma volatiles increased as ripeness approached.

Case Studies: Some case studies on jackfruit and mango, highlighting changes in chemical composition and flavour during ripening. Jackfruit showed a transition from high malic acid in unripe fruit to high citric acid in ripe fruit, along with the identification of multiple volatile compounds. Mangoes harvested at various maturities demonstrated differences in flavour profiles, with later-harvested fruit being sweeter and having distinct volatile profiles compared to earlier-harvested mangoes.

The importance of flavour is in considering preharvest conditions, including maturity at harvest, to understand and enhance the flavour quality of fruits. The timing of harvest, storage conditions and postharvest practices all have significant effects on the composition of compounds that contribute to the flavour of fruits.

POST HARVEST CONDITIONS FOR AFFECTING FLAVOUR AND SENSORY QUALITY OF FRUITS:

Various aspects of postharvest conditions and their impact on the flavour and aroma of different fruits.

Mango Storage and Flavour:

Lower storage temperatures enhance mango flavour. Ripe fruit characteristics and flavour intensity increase with storage. Mango taste improves during storage, with scores increasing from 3.54 to 8.42 after four weeks.

Volatile Biosynthesis in Pears and Apples:

In controlled atmosphere (CA) storage for pears and apples, the primary factor inhibiting volatile biosynthesis is the limited supply of precursors/substrates to enzymes, not enzyme degradation. Oleic and linoleic acids, specifically free fatty acids, play a significant role in the production of aroma volatiles in apples during CA storage. The key limiting step for volatile aroma compound production in apples is the de novo

biosynthesis of fatty acids rather than their release from membranes or storage pools.

Methyl Jasmonate and Ethylene in Apple Aroma:

The effect of methyl jasmonate on aroma volatiles in apple fruit might be mediated by ethylene.

Calcium Application for Apple Storage:

The application of calcium was shown to enhance the aroma and overall quality of Golden Reinders apple fruit during mid-term storage. This approach was suggested as a cost-effective alternative to controlled atmosphere (CA) storage.

Blood Orange Juice:

Storage temperature affects the sensory qualities of blood orange juice. High concentrations of malodourous substances, called vinylphenols, were detected in juices stored at both low (4°C) and high (25°C) temperatures for extended periods.

Orange Juice Flavour Change:

The flavour of commercial orange juice decreased most rapidly during the first one or two weeks of storage. Higher storage temperatures caused a more significant decrease in flavour scores.

Aroma Changes in Navel Oranges:

The aroma-active volatiles in navel oranges, finding that commercial packing and storage altered the aroma volatiles and reduced their flavour quality.

Strawberry Storage:

Strawberries stored in a carbon dioxide atmosphere at 5°C had a longer shelf life (11 days) compared to those stored in the air (9 days). Evaluation included components like sugars, organic acids, aroma compounds and fermentative metabolites.

Peach Fruit:

Bagging peach fruits before harvest improved fruit skin color and increased aroma volatile content. The effect of controlled atmosphere (CA) storage and UV radiation pre-storage treatment on the volatiles of peach fruit, finding significant changes during storage.

Kiwifruit Aroma:

The impact of CA storage on the volatile composition of Hayward kiwifruit, noting that alcohol metabolism played a significant role in the ripe fruit's volatile profile, especially in ester production.

Pear and Blackcurrant Volatiles:

That Bartlett pear fruits treated with 2,4-dichlorophenoxypropionic acid had a high concentration of esters. Blackcurrants stored in air and under controlled atmosphere (CA), finding that air-stored fruits synthesized more terpene volatiles and increased non-terpene compounds, such as esters and alcohols.

Litchi Fruit Aroma and Storage:

The effect of sulfur dioxide fumigation, modified atmosphere packaging (MAP) and

CA packaging on the changes in volatiles and sensory characteristics of litchi fruit. The retention of aroma volatiles in litchi fruit during storage followed the order: MAP > CA > SO2 > SO2–HCl dip, with MAP-packaged litchi fruit showing no decay and reduced pericarp browning.

Various postharvest conditions, storage temperatures and treatments exert an influence on the flavour and aroma of a variety of fruits such as mangoes, oranges, strawberries, peaches, apples, pears, blackcurrants, kiwifruits and litchi. Researchers have investigated multiple variables that impact the quality of these fruits when stored, revealing the intricate relationship between temperature, chemicals and atmosphere control.

FLAVOUR AND PACKAGING INTERACTIONS:

The change in flavour from production to consumption is crucial for the food and flavour industry. Many flavour components are chemically reactive and can interact with other product components and packaging. The flavour score of commercial orange juice decreased during storage due to ethyl acetate levels, possibly from packaging. Studies examined sorption of volatile compounds from orange and apple juice into different packaging materials. Interaction with packaging can affect microbial proliferation and vitamin C degradation. Methods for assessing interactions between volatile compounds and packaging were discussed. MAP treatment (Modified Atmosphere Packaging) improved sensory scores and retained quality in stored fresh-cut fruits.

Sensory quality of fruits is a multifaceted aspect that plays a pivotal role in consumer preferences, whether for fresh consumption or processed products. Subjective evaluation methods, including consumer acceptance tests and panel difference methods, help in gauging these attributes. The importance of flavor in fruits cannot be overstated, as it is shaped by various factors, including genetics, preharvest conditions and postharvest practices. Maturity at harvest, harvest timing and storage conditions are critical considerations. Studies on different fruits have revealed the complex interplay of factors affecting flavor, including volatile compounds, temperature and packaging interactions. Understanding and enhancing the flavor quality of fruits is essential for satisfying consumer expectations and improving market competitiveness.