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RESEARCH ARTICLE

# Chok-Anan aroma analysis: Descriptive analysis of volatiles from selected tropical plants

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## ABSTRACT

The present report describes the Descriptive Analysis (DA) of aromatic profile of some tropical plants. The standard selection criteria of the panellists was performed and preference was made to those who were familiar with tropical aromatic plants. The specific descriptive terms were by consensus among the panellists together with the analysed descriptors derived from the volatile compositions from Gas Chromatography coupled with mass spectrometry (GCMS) results. Here, we presented lists of the descriptive terms used to analyse the aromas from fresh or extract of basils, garlic, some species of the *Zanthoxylum* and rhizomes of the ginger family. In the context of testing this protocol, we performed the descriptive analysis of fresh and heated Chok-Anan mango purée. Six aromatic terms were (viz., mango identity, tropical fruit, fermented, green, sour fruit and sweet) generate by the panellists which were referred to the GCMS results. Panellists rated the intensity (scaling from 0 - 15) of the aromas. The results illustrate that green tropical fruit and mango identity were dominant in Chok-Anan mango purée. Heat treatment increased the intensity of the described mango aromas.

**Key words**: GC-MS, mangoes, odour attribute, sensory analysis

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## INTRODUCTION

Aromatic plants illustrate different volatile compositions depending largely on their genetic variations as well as the physiological states before or after harvesting (Dixon and Hewett, 2000; Niinemets et al., 2004; Pino et al., 2006; López et al., 2015; Kim et al., 2018). Human has exploited the use of natural products of aromatic substances as in food, cosmetic and perfumery industries for centuries. Among those substances, tropical aromas of plant origin are of commercial needed (Bapat et al., 2010; Cannon and Ho, 2018; Silvis et al., 2019).

Sensory characteristics are important for consumer choice of selection and acceptance, therefore, prior to accessing the quality of the product, it is vitally important to characterise the sensory profile of raw material, particularly when food processing can alter the aromatic profile of the products (Mateo et al., 1997; Saldaña et al., 2018). The most commonly used methodology for

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sensory characterisation of food analysis is Descriptive Analysis (DA), which is the technique established from Quantitative Descriptive Analysis and the Spectrum method (Lawless and Heymann, 2010). It has been widely used to profile the sensory properties of foods and beverages since it provides detailed, consistent, and reliable results (Varela and Ares, 2014). This sensory evaluation is based on the notion that perception is an average of the entire sensory experience.

Nonetheless, there is limit data on aromatic profiles particularly of descriptive sensory analysis from aromatic tropical plants and there are no refereed papers elsewhere that describe the tested terms. By performing the number of tests in aromatic and tropical plants, we have developed the procedure and ordour attributes used in many plant systems including those of Thai basil species, tropical spices of the ginger family, the *zanthoxylum* spp. and garlic (Sommano et al., 2018; Sriwichai et al., 2018; Tangpao et al., 2018). In this report we present the data on aromatic volatile analysis of Chok-Anan mango purée as to describe the aromatic identities of Thai mangoes used in fruit juice industry.

## MATERIALS AND METHODS

This protocol was conducted towards Descriptive Analysis of aromatic substances from the selected tropical volatile plants used for food, beverage and perfume industry. The standards and chemicals used are as following;

1. Standard solution of C8-C20 n-alkane (Fluka® Analytical, Munich, Germany)
2. Hexane (Sigma-Aldrich Co., St Louis, MO, USA; CAS. no.: 110-54-3)
3. Anise powder (McCormick & Company, Maryland, USA)
4. Lemon extract (McCormick & Company, Maryland, USA)
5. Thyme (McCormick & Company, Maryland, USA)
6. Ground allspice (McCormick & Company, Maryland, USA)
7. Vanilla flavour (McCormick & Company, Maryland, USA)
8. Peanut peel (Mae-ruay snack food factory Co., Ltd, Bangkuntien, Bangkok,Thailand)
9. Pine/Cypress essential oil (Chiand mai scent Co., Ltd, Chiang mai, Thailand)
10. Mango nectar (Goya foods, Inc., New Jersey, USA)
11. Granny smith apple
12. Canned pineapple (Dole food company, Westlake, California, USA)
13. Vinegar (Heinz company, Pittsburgh, Pennsylvania, USA)

### Selection of panellist

The semi-trained panellists with extensive experience in tropical aromatic crops were chosen based on their abilities to discriminate differences and ranking/rating the intensity scents. They were recruited using advertisements (Tangpao et al., 2018).

**Panellist training**

The training was intensively conducted in a 3 session per week for 4 weeks. During the first session, demographic information was collected and the evaluation protocol was introduced. Panellists were trained using commercial essential oils, fruits, spices etc. At last accessors were trained to describe the attribute definition verbally and their intensities (Viljanen, et al. 2014). During training sessions, repeatability was also assessed using replicate samples (Sriwichai et al., 2018; Tangpao et al., 2018).

**Developed attribute terms**

The attribute terms were developed from the volatile composition analysed by the GCMS with the consent of the panellist. At first generic descriptive attributes that best described odour characteristics from GCMS results were nominated, then the panellists tasted all samples and discussed the attribute definitions, attribute references, reference intensities, and evaluation procedures.

**Attribute reference**

The odour attributes and reference standards are shown in Table 1. These attributes and definitions are developed in reference to published literature.

**Evaluation session**

Twenty grams of fresh sample or 200 μL of essential oils pipetted on clean and deodourised cotton ball in testing cup cover with lid were labelled with three-digit codes and served to all panelists. Then they were asked evaluate the intensity of the given attributes in triplicates on the 15-point interval scale (0 = none, 15 = extra strong) (Pimentel et al., 2016; Tangpao et al., 2018). Clean air was obtained between each assessment. A gap of 20 s was sufficient to the individual odour assessments.

Table 1. The reference of odour attributes and intensity

| Odour Attributes | Reference Standard | n/15 | Tropical / aromatic plants | Reference |
|---|---|---|---|---|
| Anise | Anise powder, 2 g | 10 | Thai Basils | Tangpao et al. (2018) |
| Citrus | Lemon extract (McCormick), 200 μL | 8 | Thai Basils, ginger family and some *Zanthoxylum* spp. | Sriwichai et al. (2018) |
| Herb | Thyme (McCormick), 0.5 g | 10 | Thai Basils and some *Zanthoxylum* spp. | Tangpao et al. (2018) |
| Spice | Ground allspice (McCormick), 0.5g | 8 | Thai Basils and some *Zanthoxylum* spp. | Tangpao et al. (2018) |

**Table 1: The reference of odour attributes and intensity (continue)**

| Odour Attributes | Reference Standard | n/15 | Tropical / aromatic plants | Reference |
|---|---|---|---|---|
| Sweet | Vanilla flavour (McCormick), 200 µL | 10 | Thai Mangoes, Thai Basils and some *Zanthoxylum* spp. and ginger family | Sriwichai et al. (2018) |
| Woody | Peanut peel, 2 g with 100 µL DI water | 7 | Thai Basils and some *Zanthoxylum* spp. | Tangpao et al. (2018) |
| Pine | Pine/Cypress essential oil, 200 µL | 10 | Some *Zanthoxylum* spp. | Sriwichai et al. (2018) |
| Sour fruit | Mango nectar mixed with raw mango | 10 | Thai Mangoes | * |
| Ginger | Dried ginger, 10 g | 7 | Ginger family | * |
| Turmeric | Dried turmeric, 10 g | 7 | Ginger family | * |
| Green | Slices of granny smith apple | 7 | Thai Mangoes | Sriwichai et al. (2018) |
| Mango Identity | Mango nectar, 200 mL | 6.5 | Thai Mangoes | * |
| Tropical fruit | Diluted Dole canned pineapple juice with water 1:1 | 6 | Thai Mangoes | * |
| Fermented | Mango juice with 30% Heinz vinegar | 10 | Thai Mangoes | Chambers et al. (2016) |
| Garlic aroma | 3 slices of fresh garlic into 100 mL water | 10 | Garlic | Horita et al. (2017) |
| Pungent | Vinegar of wine | 10 | Garlic | Galán-Soldevilla et al. (2013) |

* Added terms from the panellists

## RESULTS AND DISCUSSION

### Mango volatile analysis

Ripe Chok-Anan mango was used as to test the protocol. The flesh (925.0 g) was puréed for 1 min in an immersion blender at high speed (HR2068 Philips, Thailand) and further blended in hand held homogeniser (T25 Ultra-turrax, Germany) for 2 min at 20,000 rpm. The purée was then heated with constantly stirring until the temperature reached 85 °C for 15 min. After heating, the purée was cooled immediately to 35 °C, filled in a plastic Ziploc bag, sealed and kept at -18 °C until used.

The Solid Phase Micro Extraction (SPME) analysis was the adapted method of Beaulieu and Lea (2003). Briefly, the slurry of mango flesh (3 mL without foam) was immediately pipetted into 10 mL glass vials containing 1.1 g NaCl that were sealed with a

steel crimp cap fitted with a Teflon/silicon septum and stored at 4 °C. The volatile aroma profile was then analysed with automated solid phase microextraction (SPME) within 8 h. GC-FID/MS analysis was carried out using an Agilent® 6890 system fitted with Flame Ionisation Detector (FID) on a fused silica capillary column (30 m × 0.25 ID × 0.25 µm film thickness). The MS source and quadrupole temperatures were set at 230 ºC and 150 ºC, respectively. Mass spectra: Electron Impact (EI+) mode 70 eV. The major volatiles analysed from the purée of Chok-Anan mango are shown in Table 2.

**Table 2: Free aromatic profiles and descriptor categories of Chok-Anan mango purée**

| Group | Free volatile compounds | Flavour descriptors |
|---|---|---|
| Pine | alpha-pinene | Pine, cedar wood |
| | beta-pinene | Dry-woody, pine like, spicy |
| | terpinolene | Sweet-piney |
| Herbal | cis-beta-ocimene | Warm herbaceous |
| | phellandrene | Peppery, minty |
| | eucalyptus | Peppery, minty |
| | delta-3-carene | Limonene-like, spicy |
| Citrus | alpha-terpinene | Refreshing, lemon-citrus |
| | limonene | Fresh citrus |
| | gamma terpinene | Refreshing lemon citrus |
| | sabinene | Floral Fragrant |
| Floral/sweet | beta-myrcene | Mild, sweet |
| | para cymene | Floral, fragrant |
| | trans-beta-ocimene | Herbaceous, weak floral |
| Camphor | camphene | Camphor, mothballs |

**Descriptive analysis of mango aroma**

Seven accessors (4 males and 6 females) age ranged from 21 – 40 years old were used to evaluate the fresh and heated purée prepared from each of the four cultivars. Training was intensively conducted in a 3 session-week for 4 weeks. By consensus within the panels, the 6 descriptive attributes that best described mango aroma characteristic were generated according to their free volatile profiles analysed (Table 3). Sensory analysis was done by descriptive evaluation of odour attributes selected from chemical profiles. During training session, the accessors were trained to describe the attribute definition verbally and their intensities (Viljanen et al., 2014). Thereafter, the panels were then presented with fresh and heated samples (~10 g sample) and the intensity of each odour attributes was rated on a linear graphical scale from 0 to 15 where; 0 = not be able to detect, 15 = strong odour.

**Table 3 Attributes and references used in evaluating in mango puree aroma**

| Aromatic attributes | Definition | Reference standards | n/15 | References |
|---|---|---|---|---|
| Sour fruit | The sour aroma associated with raw fruit | 200 mL of mango nectar mixed with 10 g raw mango | 10/15 | * |
| Green | The greenish aroma associated with unripe fruits | Slices of granny smith apple | 7/15 | Ledeker et al. (2014) |
| Mango identity | A sweet, fruity, green, somewhat woody and piney aromatic associated with mango | 200 mL of mango nectar | 6.5/15 | Ledeker et al. (2014) |
| Tropical fruit | A sweet, woody, slightly sharp, floral aromatic associated with pineapple | Diluted Dole Canned pineapple juice with water (1:1) | 6/15 | Ledeker et al. (2014) |
| Fermented | Over-ripe tropical fruit or apple cider | Concentrated mango juice with 30% Heinz vinegar | 10/15 | Chambers et al (2016) |
| Sweet | Sweet aroma similar to that of brown sugar | Sugar (5 g) | 9/15 | * |

* Added terms from the panellists

The aroma intensity of Chok-Anan mango purée by descriptive analysis is shown in Table 4

**Table 4: The aroma intensity of Chok-Anan mango purée by descriptive analysis**

| Aroma intensity | Fresh | Heated purée |
|---|---|---|
| Sour | $2.77^{b}$ | $3.18^{ab}$ |
| Green | $7.05^{a}$ | $6.14^{ab}$ |
| Mango Identity | $3.59^{cd}$ | $4.32^{cd}$ |
| Tropical Fruit (pineapple) | $3.86^{bc}$ | $4.41^{bc}$ |
| Fermented | $0.82^{c}$ | $1.32^{c}$ |
| Sweet | $2.00^{b}$ | $2.77^{ab}$ |

Values with the same superscription letter are not significantly different at $p = 0.05$

After the purée was tested heated treatment, the intensity of each aromatic attributes increased excepts that of the Tropical Fruit and Fermented aroma that remained constant. In contrast, work done on 'Chausa' mango advises that heat treatment decease the odour of this mango (Singh and Saini, 2014). Malundo et al. (1996) added that heating can decrease the intensity some volatile compounds, there by changing the overall balance of the final flavour. In addition, heating may cause structural changes to certain compounds, which can also affect the overall sensorial attribute of the fruit flavour. Our result of Chok-Anan mango purée disagrees with this.

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