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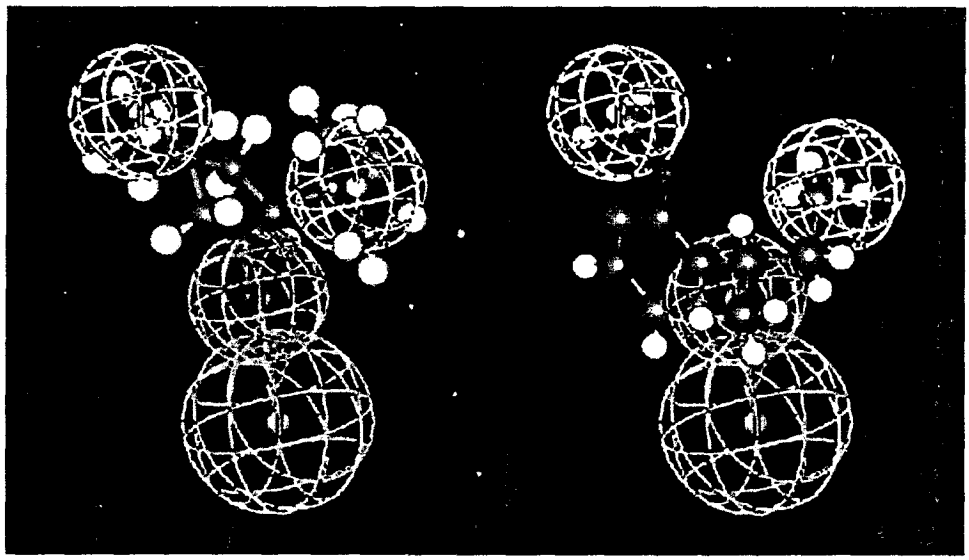

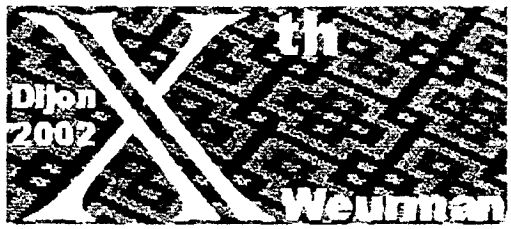

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Aroma volatiles of several unique tropical fruits and spices

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Abstract

Indonesia is rich in varieties of fruits and spices. Unfortunately, scientific information about them is very limited; meanwhile many of them are approaching extinction. Some of them, *Andaliman* (*Zanthoxylum acanthopodium* DC), *Kweni* (*Mangifera odoranta* Griff.), *Kawista* (*Feronia limonia* L.), *Jeruk purut* (*Citrus hystrix* L.) and *Pandan wangi* (*Pandanus amarylifolius* Roxb.) have strong delightful aroma as well as unique bio-activities. Their aromas are attractive to explore deeper, especially due to their potency as natural flavor sources that also possess physiological properties.

Introduction

Indonesia has plenty of tropical fruits, herbs, and spices with their profound delicacies. Some of them have been cultivated and widely known. However, many of them are merely collected from the wild ones and only known by the local tribes or communities. Scientific information about them is very limited. Many of them are not only releasing delightful unique aroma, but also they may generate exciting trigeminal effects, preserve, and produce beneficial physiological effects. These characteristics would response properly to the functional flavoring demands. Suitable handling and processing of the material would bring additional benefits to the aromatic plants, especially those that unable to be consumed freshly.

Some potential spices and herbs

Andaliman (Zanthoxylum acanthopodium DC) is one of the unique wild spices known by the Batak Angkola and Batak Mandailing, local people in North Sumatera, Indonesia (Hasairin, 1994). *Andaliman* is frequently grouped into *Piperaceae*, and named as *Piper rebesioisides* (Parhusip *et al.*, 1999). However, taxonomic verification of its leaves, stem, roots, and fruits has indicated that this spice is included in *Rutaceae*, and deserved to be named as *Zanthoxylum acanthopodium* DC. In North Sumatera, *andaliman* fruit is used to spice many different meat or fish dishes, such as *naniura*. *Naniura* is a dish made of raw meat or fish, mixed with blood, and then stored all night. *Andaliman* raw extract is proven to have antimicrobial, antioxidant and immunostimulant activity (Wijaya *et al.*, unpublished report). *Andaliman* fruit has fresh citrus like and warm sweet peppery aroma caused by terpenic compounds. According to the scoring organoleptic test, maceration in diethyl ether produces *andaliman* extract with the most representative aroma compared to vacuum headspace or maceration in other solvents, i.e. chloroform, ethanol or acetone. Monoterpenes were the main compounds among the identified ones. Geranyl acetate is the most dominant component. This fact showed that *andaliman* volatile profile is rather different from the other *zanthoxylums* such as *Z. piperitum DC and Z. simulans*, in which limonene is the major compound, as well as in *Rutaceae* plants *as Citrus japonica* (Chyau *et al.*, 1996; Wu *et al.*, 1996).

The aroma characteristic of *andaliman* is presented in table 1. Sniffing analysis with AEDA indicated that citronellal (FD 128) and limonene (FD 32) have the greatest impact on fresh *andaliman* aroma. β-Myrcene, β-ocimene, linalool, β-citronellal, geraniol, geranial, geranyl acetate, unknown compound, and a sesquiterpene were also contributing

to *andaliman* fresh citrus and warm sweet peppery aroma. In addition to its exotic aroma, *andaliman* does have a unique trigeminal effect. A substituted amide (2*E*, 6Z, 8*E*, 10*E*-N-(2'-methylpropyl)-dodecatetraenamide) has been isolated and identified as the responsible compound that 'tremble' the consumer tongues.

Table 1. Aroma characteristics of *Andaliman*.

RI(ex)[a]	*RI(ex)*[b]	*RI(ex)*[c]	*Compounds*	*FD factors*	*Aroma description*
985	988	991	β-myrcene	8	citrus, sweet, cooked
1029	1028	1021	Limonene	32	orange peel, sweet
1046	103+	1040	(z) β-ocimene	4	citrus, sweet, cooked
1097	1102	1098	Linalool	8	citrus, floral
1152	1147	1153	Citronellal	128	citrus, strong, warm
1167			Unknown	4	Green
1212	1234	1228	β-citronellol	8	citrus, warm
1227	1243	1240	Neral	8	lemon, sweet
1256	1260	1255	Geraniol	4	floral, *C. hystrix* leaf
1274	1272	1270	Geranial	8	lemon, sweet
1390	1386	1383	Geranyl acetate	4	citrus, floral, acid
1508	1500		A sesquiterpene	4	Woody

[a]RI experiment with GC-O, column HP-5; [b]RI experiment with GC/MS, column DB5; [c]RI reference: Adams (1995), column DB5; [d]Aroma compounds stated here is the one with FD factor ≥4.

Jeruk purut (Indonesia) or *Kaffir limoen* (Dutch) is also included in *Rutaceae* family (Katzer, 1998). The fruit is smaller than a human fist. It is shaped like pear, having a lot of wrinkles. The leaves are broadly ovate to ovate-oblong shaped, blunt edge, and having one petiole. The leaves have wide foliage, greenish yellow, having fresh and delicious flavor. Instead of the fruit, *Jeruk purut* leaves are frequently utilised as herbs in various Indonesian dishes. Even though *Jeruk purut* and *andaliman* are from the same family, the flavours are different. *Jeruk purut* aroma is more fragrant thus it is considered to be suitable for perfumery. Some researches showed that citronellal is the major compound of the *Jeruk purut* leaves essential oil obtained by distillation method (Jantan *et al.*, 1996). The proportion of the citronellal in *Jeruk purut* extract, however, varied with the extraction method (Wijaya *et al.*, 1995). Sensory evaluation showed no significant differences between the extracts of steam or water distillation, maceration and simultaneous distillation-extraction (SDE). However, SDE extracts give stronger aroma compared to the other ones. The essential oil obtained from sliced *Jeruk purut* leaves had more fresh character aroma. Meanwhile, mashing treatment increased the acid number and reduced the percentage of citronellal.

Other leaf locally famous as flavouring is pandan leaf. The fragrant pandan (*Pandanus amaryllifolius* Roxb. or *Pandanus latifolius* Hassk,.) can be used not only for food flavouring, but also as food colorant, room fragrance, cockroach repellent, and many others. The freshly chopped leaves are mixed with varieties of fragrant flowers to make potpourris. Fragrant pandan (*pandan wangi*) also has important roles in traditional ceremonies, such as wedding. It is also reported that *pandan wangi* is traditionally used as embrocating for rheumatic, sedative against restlessness, and to treat diabetes. The antidiabetic activity may be linked to 4-hydroxybenzoic acid which has been isolated from the root. The compound shows hypoglycemic effects in normal rats (oral administration 5 mg/kg), and increases serum insulin levels and liver glycogen content (De Guzman and Siemonsma, 1999).

Pandan wangi leave has strong and delightful aroma, worthwhile to explore deeper, especially due to its potency as natural flavour ingredient. Laksanalamai and Illangantileke (1993) reported that 2-acetyl-1-pyrroline produced specific aroma of pandan leaves. The aroma of *pandan wangi* leaves is not an essential oil, but a volatile liquid. This liquid is

directly evaporated from the epidermis tissue (Heyne *et al.*, 1987). The alkylphenols in pandan leaves are highly influenced by harvesting and ageing time, even though no new compounds are found during the ageing process, with only quantitative changes.

Because of its capacity as good flavoring, colorant, and may be good bioactive material, it is interesting to develop it into a ready to use products, for instance, *pandan wangi* encapsulated flavor. The research to make *pandan wangi* encapsulated flavor revealed that *pandan wangi* leaves extraction by maceration process, without prior heating would produce better product compared to prior heating. Alcohol (semi polar) is a better solvent compared to hexane (non-polar) and water (polar). Aging period for 3.8 hours would improve the flavor of the product. Based on the product's aroma and taste, the best processing method was aging *pandan wangi* leaves, followed by maceration in alcohol, and then followed by encapsulation process with dextrin. The aging process was conducted by mashing the leaves and then stored it in closed container. The optimum dextrin concentration was 2%.

Some potential fruits

Like other tropical countries, Indonesia has varieties of fruits, varying also in terms of cultivars. One of them is mango. There are many cultivars of mango in Indonesia. Each has different shapes and flavours. *Kweni* (*Mangifera odoranta* Griff.) is included in sweet mango groups, despite its unique flavour. The aroma is fruity, fresh green, and slightly spicy. *Kweni* is usually consumed as a part of Indonesian desert, *rujak*, or mixed with other ingredients to make icy cocktail. This fruit is rarely served as table fruit since it may irritate the consumer throat and the flesh is highly fibrous. Development of *kweni* into flavouring would widespread its utilisation, and enhance its economic value. Both its peel and flesh have strong aroma. Based on hedonic and multiple comparison analysis and aroma description evaluation, *kweni* extracts obtained by maceration produce the most similar aroma to fresh *kweni*. Hedonic test showed that there are no significant differences between the extract from *kweni* peel and flesh, although the GC profile and the aroma notes indicated that they are slightly different.

The identification of *kweni* potent aroma compounds was conducted by AEDA method. The extraction was performed by dynamic headspace analysis. The aroma characteristics of Kweni are presented in table 2. Ethyl butanoate that develop a sweet, fruity and mango-like aroma was identified as an important contributor in both peel and flesh.

Table 2. Odour active compounds in Kweni headspace extract.

Code	*Compounds*	*LRI*[a]	*LRI*[b]	*LRI*[c]	*FD-factor*	*Description*
A	Unidentified	600			2	sweet, fruity, mango like
B	Unidentified	778	809	786	8	sweet fruity, mango leaf- like
C	Ethyl butanoate	792	850	826	128	sweet, fruity, mango peel-like
D	Ethyl crotonoate	841	935	939	32	sweet, fruity
E	α-pinene	929	996	991	16	bitter, turpentine-like
F	β-myrcene	994			8	bitter, metallic, young mango character

[a] LRI experiment column DB1; [b] LRI experiment column DB5. [c] Fischer *et al.* (1995), DB1 or Adams (1995), DB5.

Besides the sweet and fruity notes, the two terpenes, α-pinene and myrcene seem to impart fresh-spicy characteristics to the *kweni* flavour; α pinene is also considered as an important compound since its aroma closely resembles the aroma of *kweni* peel, while myrcene has been described by other researchers as herbaceous and metallic as well as fresh and green-grassy (Gholap and Banduopadhyay, 1975; MacLeod and Pieris, 1984). In addition, ethyl crotonoate, and two unknown compounds are also important. Kawista (*Feronia lucida L.*) is another fruit that has unique aroma. The fruit is only locally known in

Central Java, especially on the North Coast. The ripe fruit displays cooling, astringent and tonic properties, and are used as a stomachic. The ripe fresh pulp mixed with sugar is eaten like sherbet, with or without the seeds. Local people usually process it into *kawista* syrup that has unique aroma and taste. Although included in *Rutaceae*, kawista does not display citrus notes. The aroma is also significantly different from kweni, having mild minty, sweet caramel aroma. MacLeod and Pieris (1981) suggested that SDE method is more efficient than soxhlet in order to obtain *kawista* volatile flavour. The dominant flavour compounds of fresh *kawista* and its cream are esters such as ethyl butanoate and butanoic acid. Acetone was also identified in significant amount. However, based on organoleptic test, maceration has been described as better than SDE, vacuum distillation and headspace in extracting *kawista* flavour (Kumara, 1998). There are 75 volatiles identified from *kawista* fruit extract. According to AEDA technique, ethyl butyrate has the highest FD number. Methyl butyrate and 3-methyl valeric acid are other important compounds for *kawista* flavour.

Conclusion and suggestion

All the materials that have been studied showed great potencies as sources of unique natural flavourings. Several products could be prepared with more improvements to get ready to sell products. More trials are needed to explore and utilise other interesting fruits and spices grown in Indonesia.

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References

Adams RP (1995). Identification of essential oil components by GC-MS. Allured Publishing Corp. Illinois.

Chyau CC, Mau JL, Wu CM (1996). *J. Agric. Food Chem.*, **44**: 1096.

De Guzman CC, Siemonsma JS (1996). Plant Resources of South-East Asia 13. Spices. PROSEA. Bogor.

Gholap AS, Banduopadhay C (1975). *J. Food Sci. Tech.*,12: 262-263.

Hasairin A (1994). Ethnobotany of traditional spices and dishes of Batak Angkola and Mandailing society (Indonesian). Thesis. Postgraduate Program Bogor Agric. Univ.

Heyne K (1987). *The beneficial plants of Indonesia II* (Indonesian). Yayasan Sarana Wana Jaya. Jakarta.

Jantan I, Ahmad AS, Ahmad AR, Ali NAM, Ayop N (1996). *J. Ess. Oil Res.*, **8:** 672-632.

Katzer G (1998). http://www.-ang.kfunigraz.ac.at/~katzer/engl/Citr_hys.html.

Kumara B (1998). Identification of character impact compound of kawista flavor (*Feronia limonia*) (Indonesian). Thesis. Bogor Agricultural University.

Laksanalamai V, Ilangantileke S (1993). *Cereal Chemistry*, **70**: 381-384.

MacLeod AJ, Pieris NG (1984). *Phytochem.*, **23**: 361-366.

MacLeod AJ, Pieris NM (1981). *J. Agric. Food Chem.*, **29**:49-53.

Parhusip AJN, Sibuea P, Tarigan A (1999). A study on the antimicrobial activity of andaliman (*Piper rebesioides* Wall) (Indonesian). Prosiding Seminar Nasional Teknologi Pangan. Jakarta. Indonesia. Oct. 12-13.

Wijaya CH (1995). Oriental natural flavor: Liquid and spray dried flavors of jeruk purut (*Citrus hystrix* DC) leaves. *In:* Charalambous G. *Food flavors: Generation, analysis and process influence*. Elsevier Science BV, Amsterdam, 235-248.

Wu Y, Shimoda M, Osajima Y (1996). Nippon Nogeikagaku Kaishi, **70**: 1001-1005.