

**STUDY ON EXTRACTION OF PANDAN FLAVOR FROM PANDAN LEAVES
USING STEAM DISTILLATION**

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A report submitted in partial fulfillment of the
requirement for the award of degree the of
Bachelor of Chemical Engineering

Faculty of Chemical & Natural Resources Engineering
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16 MAY 2011

ABSTRACT

Pandan is one of the leaves that contain the essence inside and release the key aroma component as their heating with the boiling point of water. The aroma compound itself is very useful for the industrial flavorings in Southeast Asia. The objective of this research is to determine the best operating parameter for the extraction of Pandan flavor from Pandan leaves using steam distillation. The parameter of the operating is varied which is the time; temperature and also the ratio of distill water with pandan leaves. Pre-treatment also been done in order to get higher removal of natural flavor from pandan leaves. The pandan compound is analyzed by using GC FID to find one of key aroma compound which is 3-hexanol by using the 3-hexanol standard curve as references. The result shown, the yield of the oil that get mostly is proportional with the concentration of 3-hexanol as one of the compound in pandan. The best condition is to get purified pandan flavor is at the 6 hours with the temperature 100°C at ratio 1:6. The study is economically feasible and it is proven to be favorable as increasing the quality of the pandan flavorings compared to the industrial. The method also that be used is suitable as using steam distillation as the extraction process which is more safe and reliable.

ABSTRAK

Pandan adalah salah satu daun yang mempunyai minyak pati di dalamnya dan melepaskan aroma komponen apabila di panaskan pada takat suhu pendidihan air. Komponen aroma tersebut begitu berguna dalam industri makanan sebagai perisa di Asia Tenggara. Tujuan kajian ini di jalankan untuk mengetahui parameter operasi yang paling sesuai untuk pengekstrakan perisa pandan dari daun pandan menggunakan penyulingan wap air. Operasi parameter dibezakan dengan masa, suhu dan nisbah antara air suling dan daun pandan. Proses awal juga dilakukan untuk mendapatkan ketepatan perisa pandan yang asli dari daun pandan. Komponen pandan di analisis menggunakan GC FID untuk mencari satu komponen aroma iaitu 3-hexanol menggunakan graf 3-hexanol yang ditetapkan sebagai rujukan. Keputusan menunjukkan penghasilan kadar minyak adalah berkadar langsung dengan kepekatan 3-hexanol sebagai salah satu komponen dalam pandan. Keadaan yang terbaik untuk mendapatkan penulinan perisa pandan adalah 6 jam dengan suhu 100°C pada nisbah 1:6. Penghasilan perisa pandan ini membuktikan bahawa ianya lebih ekonomi dan lebih berkualiti daripada industri sekarang. Proses yang juga digunakan sesuai dengan menggunakan penyulingan wap air adalah lebih selamat dan nyata.

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LIST OF ABBREVIATIONS

GC	-	Gas Chromatograph
FID	-	Flame Indicator Detector
Hr	-	Hour
SFE	-	Supercritical Fluid Extraction
HPLC	-	High Performance Liquid Chromatography
2AP		2-Acetyl-1-pyrroline

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Pandan or known as scientific name *Pandanus amaryllifolius* is a herbaceous tropical plant with long green leaves. Pandan essence is popular among the South East Asia country as flavorings for various food such as bakery products, sweets and even home cooking. In Thailand for example, pandan leaves are often soaked in water and boiled to extract the green color, a natural colorant as well as the aroma which is a bit nutty and reminiscent for freshly-cooked jasmine rice.

Now days, in our industry flavor is concentrated preparation of odorous and flavoring substances, with or without solvent or carriers, used exclusively to give food a particular smells or taste, and which amplifies or improve such smell or taste. Flavor can also be used as masking agent, which is an ingredient used for masking an unpleasant odor or taste in a food stuff or a pharmaceutical product. Flavor can also be used as a taste enhancer, which is a substance used in such small amounts as to produce little or no

odor on its own, but which to increases the odor or taste effect of other food components well above their normal level or at least enough to make them palatable.

There are two types of flavor product usually in the market which is in liquid flavour and also in powder. Today, these powdered products eventually growing because of the long term life compared to liquid flavour and also decreasing of using the additives. There are various methods in unit operation to extract to get the natural pandan flavorings substance:

1.1.1 Extraction

Organic solvent extraction is the most common and most economically important technique for extracting aromatics creation to get essence. Raw materials are submerged and agitated in a solvent that can dissolve the desired aromatic compounds. Selective dissolving, washing out or leaching out of specific substances from the called carries by way of a suitable agent usually alcohol. Commonly used solvents for maceration or solvent extraction include hexane, and dimethyl ether. The carrier as well as the extraction agent can be solid, liquid or gaseous. Maceration, digestion, percolation and infusion are processes employed in extracting substances from solid carriers.

1.1.2 Supercritical Fluid Extraction

Supercritical Fluid Extraction (SFE) is the process of separating one component the extractant from another (the matrix) using supercritical fluids as the extracting solvent. Extraction is usually from a solid matrix, but can also be from liquids. Carbon dioxide (CO₂) is the most used supercritical fluid, sometimes modified by co-solvents such as ethanol or methanol. Extraction conditions for supercritical CO₂ are above the critical temperature of 31°C and critical pressure of 74 bar.

1.1.3 Expression

Expression as a method of fragrance extraction where raw materials are pressed, squeezed or compressed and the oils are collected. In contemporary times, the only fragrant oils obtained using this method is the peels of fruits in the citrus family. This is due to the large quantity of oil is present in the peels of these fruits as to make this extraction method economically feasible. Citrus peel oils are expressed mechanically, or *cold-pressed*. Due to the large quantities of oil in citrus peel and the relatively low cost to grow and harvest the raw materials, citrus-fruit oils are cheaper than most other essential oils. Lemon or sweet orange oils that are obtained as by-products of the commercial citrus industry are among the cheapest citrus oils.

1.1.4 Enfleurage

In cold enfleurage, a large framed plate of glass, called a chassis, is smeared with a layer of animal fat, usually from pork or beef, and allowed to set. Botanical matter, usually petals or whole flowers, is then placed on the fat and its scent is allowed to diffuse into the fat over the course of 1-3 days. The process is then repeated by replacing the spent botanicals with fresh ones until the fat has reached a desired degree of fragrance saturation. This procedure was developed in southern France in the 19th century for the production of high-grade concentrates. In hot enfleurage, solid fats are heated and botanical matter is stirred into the fat. Spent botanicals are repeatedly strained from the fat and replaced with fresh material until the fat is saturated with fragrance. This method is considered the oldest known procedure for preserving plant fragrance substances.

In both instances, once the fat is saturated with fragrance, it is then called the "enfleurage pomade". The enfleurage pomade was either sold as it was, or it could be further washed or soaked in ethyl alcohol to draw the fragrant molecules into the alcohol. The alcohol is then separated from the fat and allowed to evaporate, leaving behind the absolute of the botanical matter. The spent fat is usually used to make soaps since it is still relatively fragrant.

1.1.5 Distillation

Distillation is a method separating mixture based on differences in their volatilities in a boiling liquid mixture. In the case of simple distillation, a material, usually a liquid is heated to boiling point. As the material is heated, each component substance evaporates separately when the temperature reaches its particular boiling point. The vapors are condensed in a cooler, and the resulting condensate is collected vessel. In this research the choose one for the extraction is distillation due to cost and also common method

The next step is the data will capture and analyze using High Performance Liquid Chromatography (HPLC) or Gas Chromatography (GC) in order to knowing the suitable ratio and condition to get top quality in purification of pandan flavor . Therefore much effort in this research devoted to preparing flavoring and colorings compounds from natural resources by extraction, purification and isolation to get best quality equivalence in the market. Some recommendation will be include in the conclusion.

1.2 PROBLEM STATEMENT

The current pandan natural flavorings in the market nowadays, usually have poor and the natural aroma quality. They easily get oxidized upon storage, thus making the quality of pandan flavour drop drastically over certain period of time. To overcome this problem, synthesis chemical flavour and additives is needed to be added to the pandan flavour. The additives in flavorings also in concerning because of the additives must be added in to control the aging or to preserve the flavor. The limitation of the additives in the flavor due to the regulation also taken considered because of there certain limit for every additives in the food. The used of method as steam distillation is method of extraction is taking consideration as steam distillation is conventional method but lack of publication and documentation

1.3 OBJECTIVE.

The objective of this project is to determine the best operating parameter for the extraction of Pandan flavor from Pandan leaves by using steam distillation.

1.4 SCOPE OF RESEARCH.

The scopes of works that involve of the project are,

1. To determine the yield of the extract pandan oil from the pandan leaves.
2. The suitable condition for time, temperature and the ratio between the distill water and pandan leaves in order to get the purified pandan flavor.
3. The properties of pandan flavor will be analyzing using GC FID.

1.5 RATIONALE AND SIGNIFICANT

1. Using abandoned sources to generate economy
2. Another method to extract the pandan flavor.
3. Minimizing the used of additives in the flavorings.

CHAPTER 2

LITERATURE REVIEW

2.1 OVERVIEW PANDAN


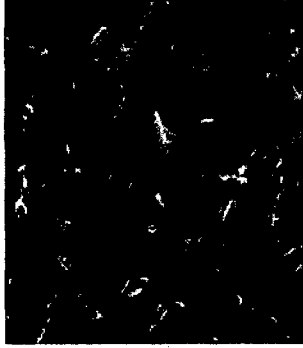
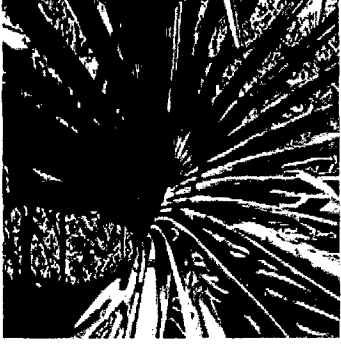
Pandan leaves or *Pandan Amaryllifolius* can be found widely in tropical countries such as those in the Pacific islands, Africa, Australia and South Asia, and because of its high amount of chlorophyll, it is becoming popular in use as a green food colorant in pandan-flavored cakes, ice cream and custards, for example. Synthetic colorants are often used in these items, and this study proposed that a more natural colorant might be more desirable to health-conscious consumers.

2.2 PHYSICAL PROPERTIES OF PANDAN

Pandanus is a genus of monocots with about 600 known species. Plants vary in size from small shrubs less than 1 meter (3.3 ft) tall, up to medium-sized trees 20 meters (66 ft) tall, typically with a broad canopy and moderate growth rate. The trunk is stout, wide-branching, and ringed with many leaf scars. They commonly have many thick prop roots near the base, which provide support as the tree grows top-heavy with leaves, fruit, and branches. The leaves are strap-shaped, varying between species from 30 centimeters (12 in) up to 2 meters (6.6 ft) or more long, and from 1.5 centimeters (0.59 in) up to 10 centimeters (3.9 in) broad.

They are dioeciously, with male and female flowers produced on different plants. The flowers of the male tree are 2–3 centimeters (0.79–1.2 in) long and fragrant, surrounded by narrow, white bracts. The female tree produces flowers with round fruits that are also bract-surrounded. The fruits are globose, 10–20 centimeters (3.9–7.9 in) in diameter, and have many prism-like sections, resembling the fruit of the pineapple. Typically, the fruit changes from green to bright orange or red as it matures. The fruit of some species are edible.

Table 2.1: These are several species of *Pandanus*

Species	Explanation
<p data-bbox="427 280 691 309"><i>Pandanus tectorius</i></p> 	<ul style="list-style-type: none"> - Occurring from near Port Macquarie in New South Wales to northern Queensland, Australia and Indonesia through the islands of the tropical Pacific Ocean to Hawaii (where it is known locally as the <i>hala</i> tree). - The fruit can be eaten raw or cooked and is a major source of food in Micronesia, especially in the atolls. The fibrous nature of the fruit also serves as a natural dental floss. - The leaves of the tree are often used as flavoring for sweet dishes such as kaya jam, and are also said to have medicinal properties. Leaves were used by the Polynesians to make baskets, mats, outrigger canoe sails, thatch roofs and skirts.
<p data-bbox="395 940 730 969"><i>Pandanus Amaryllifolius</i></p> 	<ul style="list-style-type: none"> - It is an erect green plant with fan-shaped sprays of narrow, blade-like leaves and woody aerial roots. The plant is sterile, flowers only very rarely, and is propagated by cuttings. - The characteristic aroma of pandan is caused by the compound 2-acetyl-1-pyrroline which also gives bread, jasmine rice and basmati rice, and bread flowers (<i>Vallaris glabra</i>) their typical smell.
<p data-bbox="443 1377 691 1406"><i>Pandanus Spiralis</i></p> 	<ul style="list-style-type: none"> - It is a shrub or small tree up to 10 meters in height native to northern Australia. Commonly called screw pine, pandan palm or screw palm despite being neither a true palm nor a pine. - The fiber of the leaves can be used as string for dilly bags. Other uses include baskets, mats, and shelters. In addition, mashed leaves can be used to cure headaches when wrapped around the head. The Burarra people use the plant to make fish traps.

2.3 USES OF PANDAN

2.3.1 Flavor and coloring use

In Thailand, Malaysia and Indonesia, pandanus leaves are valued because their fragrance enhances the flavour of rice. Plain rice cooked in coconut milk and flavoured with pandanus leaves also the rice steamed in small baskets made from pandanus leaves, as often prepared in Indonesia. Pandanus leaves are very popular on Bali (bay-leaf). Lesser rice varieties are often cooked with pandanus leaves to simulate the flavour of the expensive types. Pandanus leaves impart not only flavour, but also green colour to the rice.

2.3.2 Medicine use

As can be observed, the uses of the pandan tree are not limited to cooking uses. Its leaves and roots are found to have medicinal benefits. Such parts of the plant have been found to have essential oils, tannin, alkaloids and glycosides, which are the reasons for the effective treatment of various health concerns. It functions as a pain reliever, mostly for headaches and pain caused by arthritis, and even hangover. It can also be used as antiseptic and anti-bacterial, which makes it ideal for healing wounds. In the same manner, a preparation derived from the bark of this plant may be used to address skin problems. Many people have also discovered that it is an effective remedy for cough. In India, pandan leaves are being used to treat skin disorders like leprosy and smallpox. The bitter tasting quality of the leaves makes it ideal for health problems which include, but

are not limited to, diabetes fever, ulcer and wounds. In Hawaii, pandan flowers are being chewed by mothers who later give the chewed flowers to their children, as laxative. The juice extracted from pounded roots of this tree is used and mixed with other ingredients to ease chest pains. Also, it is used as tonic for women who have just given birth and who are still in weak states. Pandan flowers have also been traced with characteristics that function as aphrodisiac. Pandan also manifests anti-cancer activities.

2.3.3 Industrial use

In cosmetic industry, pandan leaves used in the processing of soap which as a fragrant scent. Pandan is said to be a restorative, deodorant, indolent and phylactic, promoting a feeling of wellbeing and acting as a counter to tropical lassitude. It may be chewed as a breath sweetener or used as a preservative on foods. Mid-eastern Indians use the flower of this plant in making perfume, while in Thailand, the leaves are often used as flavourful wrappers for morsels of food, as the leaves will leave their aroma in the food.

2.4 CHEMICAL PROPERTIES IN PANDAN

2.4.1 2-acetyl-1-pyrroline

2-Acetyl-1-pyrroline, abbreviated 2AP, with the IUPAC name 1-(3,4-dihydro-2H-pyrrol-5-yl)ethanone, is an aroma compound and flavor that gives white bread, jasmine rice and basmati rice, the spice pandan (*Pandanus amaryllifolius*), and bread flowers (*Vallaris glabra*) their typical smell. 2-Acetyl-1-pyrroline and its structural homolog, 6-acetyl-2,3,4,5-tetrahydropyridine of similar smell, can be formed by Maillard reactions during heating of food such as in baked bread. Both compounds have odor thresholds below 0.06 ng/l.

The first AP (2-Acetyl-1-pyrroline) is identified and determined as an important compound contribution to popcornlike aroma in several Asian aromatic rice varieties (Buttery, 1982). Paule and Powers (1989) reported AP in Basmati 370, an aromatic rice from Pakistan, and positively correlated the AP concentration with descriptive terms (popcornlike aroma as described by non-orientals and pandan like aroma as described by orientals).

The AP compound was later identified as a major component of the volatile oil of freeze-dried pandan (*Pandanus amaryllifoliosus*) leaves. However, the concentration of AP in the freeze-dried pandan leaves was 10 times greater than that found in milled, scented rice varieties and 100 times greater than that found in common milled rice. Extensive panel evaluations showed that AP had a significant positive correlation with descriptive terms (popcornlike or popcornlike aroma). Therefore, some Asian people may traditionally use pandan

leaves while cooking common non aromatic rice to impart a resemblance of the aroma to the cooked rice.

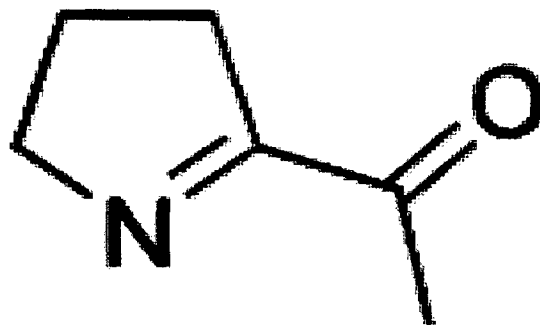


Figure2.1: The chemical structure of 2-Acetyl-1-pyrroline

2.4.2 Others Volatile Component in Pandan Leaves

Table 2.2: Others Volatile Component in Pandan Leaves

3-methyl-2-(5H)-furanone	3-hexanol	3-hexanone
3-methyl-2-(5H)-furanone as main component volatile in pandan beside -hexanol, 4-methylpentanol, 3-hexanone and 2-hexanone (Flavor and Chemistry of Ethnic Foods, Cancun, Nov. 11-15, 1997 (1999).	3-Hexanol (IUPAC name, also called ethyl propyl carbinol) is an organic chemical compound. It occurs naturally in the flavor and aroma of plants such as pineapple and is used as a food additive to add flavor.	3-Hexanone has odor type fruity, sweet and waxy with a rum notes (Mosciano, Gerard P&F 15, No. 1, 19, 1990). It appears as volatile component in pandan same as 3-hexanol.