

Improving the Production Quality of Atsiri Oil Industry Through the Introduction of Equipment and Diversification of Raw Materials

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ABSTRACT

The wealth of spices is a potential that can be developed in the procurement of atsiri oil. Development of atsiri oil processing have been performed in many clove crops. However, the raw materials of clove are not able to meet demand of atsiri oil production, the artisans of atsiri oil need to be given the knowledge and skills to cultivate atsiri oil with alternative materials other than clove leaves. Based on the above issues, this study aims to develop innovative products of atsiri oil by using material that are more varied in addition to clove leaves, and to develop a method of using devices for processing atsiri oil. This research is applicative, so the main purpose is to record and solve the problems adjusted to the needs. The research method is a cross-sectional method by observation and survey, followed by requirement analysis, model development and training module, implementation of the model and evaluation of the model implementation. Results show that the prospects of essential oils of ginger and lime can be used to support the fulfillment of foreign and domestic market demand. Atsiri oil processing process can be done through the process of distillation in three ways, namely distillation with boiled, steamed and direct steam. As for the lime oil done by using pressing method, the appropriate method of using a distillation apparatus can result in more innovative atsiri oil production through diversified commodities.

Keywords: production quality, atsiri oil, equipment, diversification of raw materials.

1. INTRODUCTION

The processing of atsiri oil in Indonesia has been done since the colonial era. The richness of spices is a potential that can be developed in the provision of atsiri oil. Indonesia has great potential to develop atsiri oil, because it has a large enough area suitable for the development of plants producing atsiri oil, viewed from the potential of the soil and climate. When viewed from the market opportunity, atsiri oil has a market opportunity that is still open, both for markets in the country and abroad. Various types of plants can be developed in the procurement of atsiri oil such as: patchouli leaves, cloves, fragrant roots, sandalwood, ginger, camphor, cinnamon, eucalyptus, cherry, kenanga, pepper, nutmeg, citronella, fennel, eucalyptus, Gandapura, cardamom, lemon,

orange, jasmine, palmarosa, and peppermint. Various types of plants are thriving in all parts of Indonesia that has a tropical climate. The following is the spread of crop-producing areas that can be developed into atsiri oil:

Table 1. The Areas Of Plants Producing Atsiri Oil In Indonesia

No.	Plants	Plants Producer Area
1	Patchouli Leaf	<ul style="list-style-type: none"> ▪ Lhokseumawe, Nangroe Aceh Darussalam ▪ Pasaman, West Sumatera ▪ Dairi, North Sumatera ▪ Lampung ▪ West Java ▪ Wonogiri, Central Java
2	Clove	<ul style="list-style-type: none"> ▪ North Sumatera ▪ Central Java ▪ Southeast Sulawesi ▪ Maluku ▪ Papua Barat
3	Eucalyptus	<ul style="list-style-type: none"> ▪ South Sumatera ▪ Southeast Sulawesi ▪ Buru Island , Seram Island, Nusa Laut, Ambon, Maluku ▪ East Nusa Tenggara ▪ Irian Jaya
4	Ylang Ylang	<ul style="list-style-type: none"> ▪ Malingping, West Java ▪ Blitar, East Java
5	Citronella fragrance	Jawa Island
6	Fragrant root	<ul style="list-style-type: none"> ▪ Garut, West Java
7	Cinnamon	<ul style="list-style-type: none"> ▪ West Sumatera ▪ North Sumatera ▪ Central Java ▪ Maluku

Source: Data have been Processed by Researcher

The table shows that Indonesia has many areas that can support the raw materials in producing atsiri oil to meet the needs of both national and abroad market. So far, the largest contributors to atsiri oil producing are from eastern Indonesia, such as Sulawesi and Maluku. However, Java Island that is quite densely populated also has a supportive area to produce atsiri oil, especially Wonogiri Regency in Central Java Province. Wonogiri regency so far has been known as one of cashew nut producers, but since recent years has also paid special attention to plants producing atsiri oil. This can be seen in the Medium Term Regional Development Plan of Wonogiri Regency of 2016-2021 which is stated in harmony between vision, mission, goals, and goals.

One of mission that reflects the attention of Wonogiri Local Government in developing the atsiri oil industry can be seen in the fourth mission which is "Increasing Wonogiri Productivity and competitiveness in all fields so that Wonogiri can move forward and rise with other regions". Furthermore, to realize the mission is supported by several objectives namely improving the performance of regional economy through the agricultural sector which is characterized by increasing of agribusiness facilities, increasing agricultural production centers, as well as increasing market network and agricultural processing industries. With reference to regional superiority and local government support, the production of atsiri oil in Wonogiri can be developed through collaboration with research institutes in setting up assembly technology to increase productivity, processing product and improving the quality of atsiri oil is quite large, so

the productivity and quality, which is currently still under optimum still has the potential to be upgraded.

Development of atsiri oil processing in Wonogiri is mostly done on clove plant commodities. However, by 2014, the atsiri oil industry in Wonogiri has decreased drastically in its production. This is due to the scarcity of raw materials in the form of clove leaves. The scarcity of raw materials is due to some areas in Wonogiri attacked by bacterial pests that attack the clove stem, consequently many trees dead and many leaves that do not grow well. The atsiri oil industry in Wonogiri, which is usually able to produce an average of 3-5 kettle of essential oil per day, can only produce one to two boilers per day.

In the beginning, the scarcity of raw materials can be overcome by finding the source of raw materials from other regions. However, when the area which has the primary source can develop independently, hence the scarcity of raw materials is increasing in other areas. The potential for atsiri oil industry is very large, both the local market and overseas market. This is because atsiri oil is needed for various industrial chemicals aromatic and toiletries, as well as pest control industry. Demand continues to increase from year to year, but not fulfilled because of the scarcity of raw materials increasing. Therefore, it is necessary to diversify the raw materials in producing atsiri oil in Wonogiri.

So far, the main raw material in producing atsiri oil in Wonogiri comes from clove, however, to overcome the scarcity of raw materials in the form of clove leaves, farmers of atsiri oil need to be given knowledge and skill to process atsiri oil with alternative raw materials other than clove leaves. The alternative plants in addition to cloves that are widely found in the agricultural area of Wonogiri are patchouli leaves, ginger and also lime. Based on the description, it can be formulated that the main problems in producing atsiri oil in Wonogiri Regency are as follows:

- a. Raw materials, the acquisition of raw materials often experience difficulties due to not optimal use of land for planting raw materials and due to clove tree pest attacks;
- b. Product innovation, lack of experience triggers the lack of product innovation with alternative raw materials other than clove leaves;
- c. Equipment, lack of equipment used results in low quantity and quality of production.

With reference to the above issues, this study aims to develop innovative products of atsiri oil using more varied materials excepting clove leaves, and develop methods of using tools processing atsiri oil. Furthermore, the benefits derived from this research are as follows:

- a. Development of entrepreneurship science, developing theories in the science of entrepreneurship, as a discipline that studies about one's ability in facing life's challenges through the application of creativity and innovation to meet the needs and market opportunities;
- b. Development of creative industry, increasing value-added of atsiri oil products technically so as to have competitiveness in the market;
- c. Structuring local industry as soon as possible, localization of business with adequate access support, and provision of infrastructure in favor of the craftsmen of atsiri oil can provide added value and competitiveness of atsiri oil in competing with various foreign products that flood market in Indonesia.

2. LITERATURE REVIEW

Indonesia has various plants sources of atsiri oil from various parts of the plant, among others:

- a. Taken from the leaves: cloves, patchouli, citronella, betel, eucalyptus, lime, turmeric, key
- b. Taken from the fruit: fennel, orange, cumin, coriander
- c. Taken from its rhizomes: ginger, turmeric, kencur, galangal, lempuyang sari.
- d. Taken from its roots: fragrant root
- e. Taken from its bark: cinnamon

Based on this condition, the production of atsiri oil should not only be focused on one species only, but it needs diversification of raw materials.

2.1. Atsiri Oil

Atsiri oil is included volatile secondary metabolite products and present in various parts of plant such as tubers, roots, stems, skins, leaves, flowers and seeds. *Encyclopedia of Chemical Technology* states that atsiri oil is fluid compounds, obtained from parts of plants, roots, skins, stems, leaves, fruits, and seeds or from flowers by means of steam distillation. Based on the chemical composition, atsiri oil consisting of hydrocarbons and oxygenated hydrocarbons. Furthermore, Guenther (1987) mentions the properties of atsiri oil are as follows:

- a. Smell the fragrance according to the scent of the crop
- b. Easy to evaporate at room temperature without decomposition
- c. Having a bitter taste (pungent taste)
- d. Generally soluble in organic solvents (alcohol, ether, petroleum, benzene)
- e. Insoluble in water

Based on its use, the benefits of atsiri oil can be classified into the following industries:

- a. Cosmetics and perfumes industry atsiri oil is used as perfume of soap manufacture, toothpaste, samphoo, lotion, and perfume.
- b. Food industry, atsiri oil is used as perisa or add flavor.
- c. The pharmaceutical industry, atsiri oil is used as an anti-pain, anti-infective, and bacteria killer.

Industry of atsiri oil processing in Indonesia that has actually existed since the colonial era, when viewed from the quality and quantity did not undergo much change. This is because most of the atsiri oil processing units in Wonogiri region still use traditional technology, which generally have limited production capacity. For other regions, especially outside Java Island such as Sulawesi, Maluku and Papua already have atsiri oil processing supported by sophisticated technology. For these areas, atsiri oil is a contributor to local revenue because it is supported by abundant natural resources of plants producing atsiri oil.

2.2. Alternative Commodities in Development of Atsiri Oil

Scarcity of clove raw material to produce atsiri oil as discussed above, it is necessary to find alternative raw materials that can be developed for the procurement of atsiri oil, among others, with patchouli, ginger and lime leaves. The Indonesian people have generally known and utilized these plants in daily life for various purposes, such as food, beverage, cosmetic, perfume and other ingredients ranging from the traditional level, both in rural communities to modern urban communities. The condition of agriculture in Wonogiri area, has sufficient land for patchouli, ginger, and lime as raw

material for making atsiri oil. However, so far the farmers of atsiri oil only use the raw material of clove leaves as a material of making atsiri oil.

Patchouli leaf or known with the Latin *pogostemoncablinbenth* is a tropical shrub that produces a kind of atsiri oil. In international trade, patchouli oil is known as patchouli oil because the oil is distilled from the leaves. To produce atsiri oil, patchouli leaves are harvested at the age of 7-9 months and then can be harvested once again in the next 3 to 4 months. Harvest is done at the bottom of the patchouli leaves in a state of yellowing color. After the age of 3 years, patchouli seed harvest should be done in the morning or afternoon, if patchouli leaves harvested during the day the oil content is reduced. All branches contained on the patchouli leaves are cut, except one to stimulate the growth of new branches. After harvesting, patchouli leaves should be dried first. Patchouli leaves dried and flipped, for 5 to 8 hours. The patchouli leaves are wilted, aerated on a bamboo rack. Drying time is 3 to 4 days. After the patchouli leaves dry, then the patchouli leaves can be distilled to be processed into atsiri oil.

Ginger or known by the latinname of *zingiberofficinalerosc* is one type of plant belonging to the tribe of *zingiberaceae*. Ginger is known by the common name of ginger or garden ginger. Ginger plants are thought to have originated from Asia and are the first known spices in Europe (Ravindran et al., 2004). In Indonesia ginger is a type of herbs that have been widely used, it is seen in the processed ginger which is usually enjoyed as food, beverage, and also as a raw material of essential oil. As an herbal plant, ginger stores various good substances for the body such as prevention of cancer, respiratory problems, digestion, overcoming bruising and pain. In addition ginger is also able to provide benefits to the beauty of overcoming the skin oily and eliminate dandruff.

Ginger can grow in rainfall environment conditions around 2500-4000 mm per year, at a temperature of 25-35 degrees C, and with humidity of medium and high. Ginger plants require fertile soil, loose, rich in humus and well drained; It can also grow in the soil latosol red brown and soil andosol. The process of producing atsiri oil using raw materials of ginger is done by distillation through steam distillation or water distillation. The process begins by separating the ginger rhizome from the plant tissue through the distillation process. In this process, the ginger plant tissue is heated with water or water vapor. Further, the volatile oil will evaporate from the network along with water vapor formed or with moisture passed on the material. The subsequent process, a mixture of water vapor and atsiri oil is condensed on a conduit with a relatively low temperature. The result of condensation in the form of a mixture of water and atsiri oil is very easy to separate because the two materials can not dissolve each other.

For the distillation method, the content of atsiri oil in a ginger rhizome, approximately one to three percent. There are several techniques of atsiri oil distillation on ginger rhizome that can be done, namely boiling method, steaming method, and direct steam method. In boiling method, the ginger rhizome is boiled in boiling water, the atsiri oil will evaporate with water vapor, then pass through the condenser for subsequent condensation. The tool used for this method is called a boiling distiller.

For steaming method, the ginger rhizome is steamed in the kettle whose construction is almost the same as the corm, then the atsiri oil will evaporate and be carried away by the flow of water vapor that flows into the condenser for condensation. The tool used for this method is called the steamer's flute.

In the direct steam method, the ginger rhizome flows with steam derived from the steam generator boiler. The volatile oil will evaporate and be carried away by the flow of water vapor that flows into the condenser for condensation. The tool used for this method is called a direct steam distillation apparatus. Generally, most farmers do steaming method because the quality of atsiri oil products produced is quite good, the process is quite efficient, and the price of the tools is not too expensive.

Lime or known by the latin name *Citrus hystrix* included in the category of citrus spices, which generally have a tree height between 2 and 12 meters. Physical characteristics of lime tree can be known from the stem is rather small, crooked or angled and branched low. Stems that have old are round, dark green, can be plain or mottled. Lime leaves are yellowish green and smells delicious. The shape is round with a blunt and stemmed end. The winged leaf stalk is wide, so it almost resembles a leaf. Lime is one of the raw materials in producing atsiri oil obtained by distillation through steam method. The materials used are the leaves or peel of the lime. Atsiri oil derived from the skin of lime is widely used as a cosmetics maker, perfume, antiseptic, and others. The oil of lime leaves in international trade is called as kaffir lime oil.

2.3. Production of Atsiri Oil

Production of atsiri oil can generally be divided into two groups, namely mechanical methods and physical-chemical methods.

2.3.1. Mechanical Method

This method is often called the expression is cold pressing no heat is needed in this way. The process is squeezing. Basic ingredients that can be taken oil with the mechanical pressing usually in the form of seeds or nuts or fruits (citrus oil). Some fruit that contains citrus oil such as bergamot, grapefruit, lemon, lime, mandarin, orange, and tangerine. There are three different ways to pick up citrus oil:

- a. Sponge, done manually (by hand). The flesh is separated, the skin of the fruit and the seeds are soaked in hot water. After more elastic then sponge / foam attached to the skin of the fruit and pressed. The atsiri oil that comes out will be absorbed by the sponge. Once saturated, collected by squeezing sponge.
- b. Equelle a piquer, it is more energy efficient than sponge. This method is no longer done manually but with a tool that is rotated and equipped with nails on the edges to pierce oil cells on the skin of the fruit. Atsiri oil and pigments can be removed from the skin of the fruit, then the atsiri oil can be separated.
- c. Machine abrasion, almost the same with b way. The machine can remove the skin of the fruit and put it into the centrifuge by adding water. This centrifugal separation runs very fast, but because the atsiri oil is mixed with other substances, it is likely that there may be changes due to the effect of the enzyme.

2.3.2. Physical-Chemical Methods

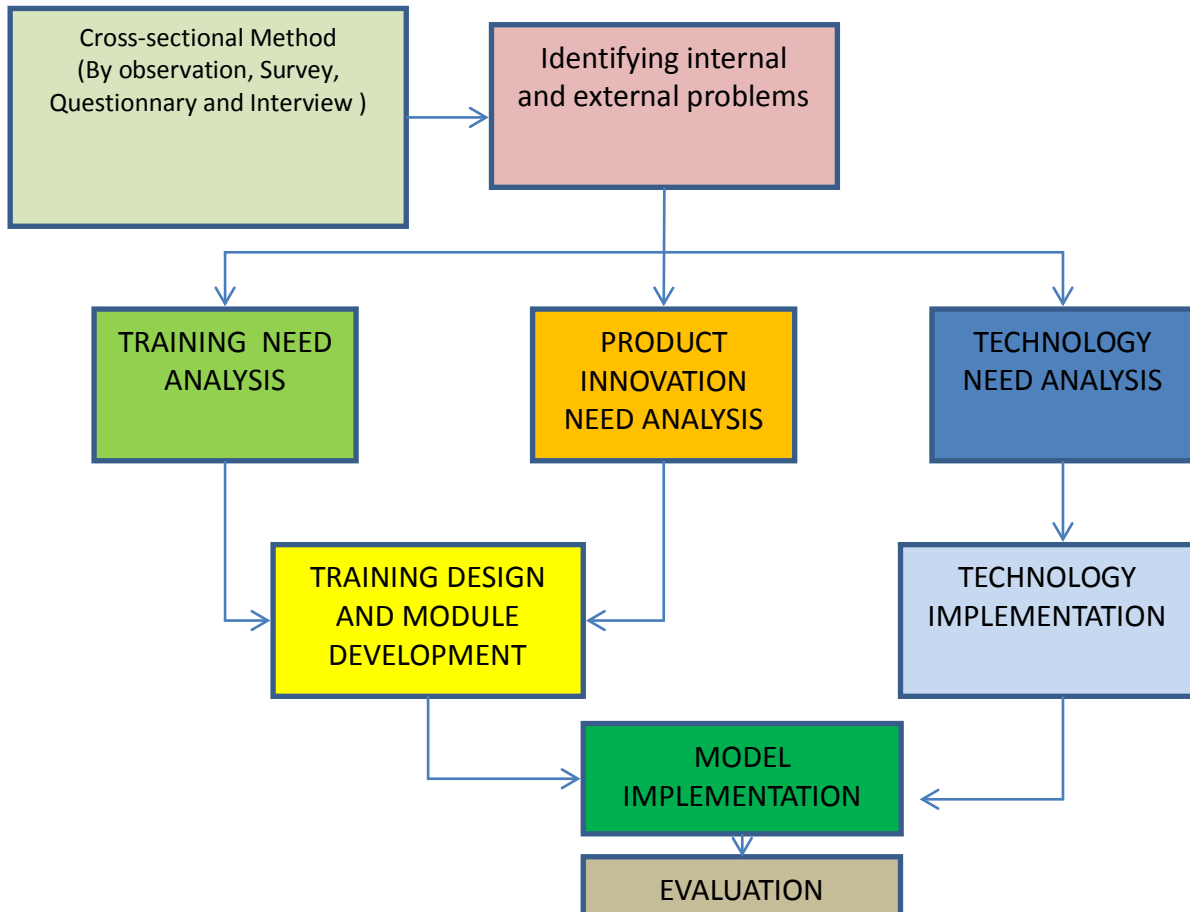
- a. Distillation. With this type of water distillation, the material to be distilled is directly related to boiling water. The material to be distilled may be floating on water or submerged entirely, depending on the specific gravity and quantity of the material to be processed. Water can be boiled with fire directly. This method is also called boiling method. When the material is boiled, the atsiri oil will evaporate with water vapor, then pass through the condenser to be

condensed. The tool used for this method is called the boiling distiller. Examples of materials processed by this method: roses, orange blossoms. Water distillation can run at pressures below 1 atmosphere so that water can boil at temperatures lower than 100 °C. This method is usually done when the material or atsiri oil is susceptible to temperature.

- b. Distillation or Steaming. The material from plant to be processed is placed in a container whose construction is almost the same as the steamer's vessel, so this method is also called steaming. Water is boiled at the bottom of the tool. Atsiri oil will come along with the steam stream which is then flowed into the condenser. The tool used in this method is called the steamer distiller. Steam temperatures should be controlled to be sufficient to force the material to release its atsiri oil and not to burn the material. Steam used pressurized > 1 atm and temperature > 100 °C, so that distillation time can more quickly reduce the possibility of damage to atsiri oil. This method produces atsiri oil with high quality.
- c. Direct steam distillation. The material is fed by steam from a steam generator. The resulting vapor typically has a greater pressure than the atmosphere. The resulting vapor is then flowed into a distillation apparatus so that the atsiri oil will be carried away by the flow of water vapor to the condenser for condensation. The tool used in this method is called a direct steam distillation apparatus. Basically there are no striking differences in the three distillation tools. However the selection depends on the method used, because a particular reaction can occur during the distillation.
- d. Kohobasi. The kohobasi system is a repeated distillation process, meaning that the remaining output water is fed into the boiler again for reprocessing to steam, then steam is passed to the distillation tube. In the distillation tube contact with the raw material to produce steam water and atsiri oil then separated by the separator produces atsiri oil and waste water (waste). When rose oil is collected by water distillation, the phenyl ethyl alcohol it contains will dissolve in water. This compound does not come with atsiri oil. The smell of different atsiri oils is called incomplete oil. To get the complete atsiri oil, phenyl ethyl alcohol is separated from water by distillation and then added to incomplete oil with the right ratio. This complete Rose oil is called Rose Otto.
- e. Rectification. When distilled atsiri oil contains impurities, it can be purified by re-distillation using steam or vacuum. Purification in this way is called rectification. Ct. Eucalyptus oil, sold as double distilled.
- f. Fractionation Distillation. The distillation process is normal, but atsiri oil is collected in batches (by fraction). In the process of extracting atsiri oil by extraction, atsiri oil to be extracted by the oil are added to the solvents or materials which can bind the oil contained in the atsiri material. The solvent mixed with the atsiri oil will then be separated for its atsiri oil. Solvent extraction to collect atsiri oil, not only using chemical solvent such as hexan, but also with solid solvents such as fat / solid oil. It can also be with CO₂. Solvent extraction is especially suitable for materials with very low atsiri oil content, as well as for thermolabile materials. With this type of process, non-volatile compounds such as waxes and pigments are extracted.

3. RESEARCH METHODS

This research conducted cross sectionally by studying subjects and objects of research within a certain period. The location of this research is in Wonogiri Regency, Central Java Province. The Sample of research is conducted at the center of a small industry of atsiri oil production, namely: CV Giri Putra and CV SekarMelati in District of Girimarto, Wonogiri. The research method is described as follows.



4. RESULT

Wonogiri regency is one of regencies in Indonesia, located in an area of 182,236.02 hectares. The landscape dominated by mountains and hills, making the Wonogiri area has enough potential areas as diverse as trade, mining, potential of nature tourism, agriculture and farming, and industry sector. One of the promising industry in Wonogiri district is atsiri oil industry. According to data from the Central Bureau of Statistics from the census of agriculture in 2013, the number of clove trees in Wonogiri amounted to 111.416, and the number of clove trees in Central Java province reached 1.892.020. So the clove trees in Wonogiri reached 6% of whole clove trees in Central Java. Atsiri oil industries in Wonogiri depend on the centers of cloves, because the raw materials of atsiri oil is dominated by clove leaves.

Request for production of atsiri oil continues to increase, can not be fulfilled when only rely on raw materials of cloves. Thus, in order to overcome the scarcity of raw materials such as clove leaves, then the craftsmen of atsiri oil is necessary given the

knowledge and skills to cultivate atsiri oil with alternative materials besides leaf clovers, namely the ginger and lime. Wonogiriarea, especially the district of Girimarto is possible for development of innovative products of atsiri oil with raw materials of ginger and lime. Ginger production in Wonogiri district is quite large compared to other areas in Central Java. Likewise lime products in Wonogiri is alsorelatively abundant, due to natural conditions in Wonogiriarea allow the limeplant to grow and develop well.

This research is applied research or a direct application in everyday life. The results of the research is in the form of a solution that can truly be given to the community. Based on the observation of local craftsmen for atsiri oil, which is done by the method of direct observation and interviews, obtained accurate data as a reflection on what to do. Thus, with the method it can be concluded that in order to increase the quantity and quality of atsiri oil products, in addition to innovative processing methods, also required the introduction of more adequate equipment.

The method used by the community was initially done through cooking techniques, then converted to steam distillation system. Most of the atsiri oil products in Indonesia is produced by using a simple distiller. The craftsmen are using drums or steel plate tool and plumbing to create tools refiners. The materials are easily corroded and cause the oil into a dark color so that the quality of the oil is low. So that it is necessary to give technical assistance in the processing so that the productivity and quality of the oil produced will be better.

Based on studies in the field, it is necessary to the process of assistance in the processing of atsiri oil, wherein the current moment the production of atsiri oil can be done by, among others: (a) distillation (distillation), (b) pressing (expression), (c) extraction using solvent (solvent extraction), and (d) adsorption by the solid fat (enfleurasi). Among the four methods that are widely used by the industry of atsiri oil is the distillation. Distillery is the oldest method of extracting the atsiri oil processing. This method is suitable for atsiri oil that are not easily damaged by heat, such as clove oil, patchouli, lemongrass, nutmeg, root fragrant and ginger

As for the type of lime, production of atsiri oil can be achieved by pressing which is done by putting pressure on the material using a device called a hydraulic or expeller pressing. The method of distilling of atsiri oil can be done in three ways: (1) distilling with water (water distillation) , (2) water-vapor distillation (water and steam distillation), (3) direct steam distillation (steam distillation).

Pressure of temperature and duration of the refining process is set based on the type of commodity to be treated. For the type of ginger takes about 10-16 hours depending on the type of raw material (wet / dry). Distillation is better starting with low pressure, then increase gradually until the end of the process. During the refining process, the water vapor is condensed and fell to the bottom of the kettle must be removed periodically through the tap discharge of water to prevent the porous steam pipe submerged. The next process is the process of cooling and oil separation, which is done by filtering using a Teflon cloth / screen printing.

CONCLUSION

The prospects of atsiri oil of ginger and lime can be used to support the fulfillment of the demand for overseas and domestic market. The processing of atsiri oil can be done through a distillation process in three ways, namely: distillation with boiled, steamed and direct steam. As for the lime oil is done using pressing method.

The use of atsiri oil continues to increase in line with the development of the perfume industry, soap and cosmetics, pesticides and other industries. Based on this, it can be concluded that through the method of using appropriate distillation tool can produce atsiri oil more innovativethrough diversified commodities.

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