Application of styrax essential oils in healthy and beauty soap products

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Abstract. Styrax resin is the main non-timber forest product from North Sumatra, Indonesia. Unfortunately, the precious resin known as benzoin still have not been developed into various domestic and innovative organic personal care products. The objective of study is to initiate the distilled styrax resins utilization into personal care products in form of organic and healthy washing hand soaps. Research was carried out by distilling styrax resin, formulating and producing soaps, and assessing the products acceptance. Product application tests were applied including soap properties (hardness, cleansing, conditioning, bubbly and creamy), feeling and preference tests (sensibility, moisturizing, smoothness, scent). Forty respondents were surveyed, which 35 individuals (87.5%) expressed their pleasure utilizing the soaps, related to good consistency and cleaning performance, smoothness, moisturizing, as well as easily rinsed from hands after washing with a pleasant long lasting aroma. The phytochemical content contained is also reveals soap potential application to reducing anxiety and increase immune system. The results showed the idea about processing styra x resin into organic and healthy personal care products is highly feasible for replication in wide-scale applications. Regarding the products contains organic ingredient, it is considered better, healthier and support the local economy development.

1. Introduction
Styrax resin is the main non-timber forest product from North Sumatra, Indonesia. The precious resin is harvested from the Styrax sumatrana tree and has been a major trading commodity since the 6th century [1]. Thousands tons of raw resin are shipped overseas, whereas various incense derivatives in the form of medicines, perfumes, beauty and food ingredients worth millions of dollars are imported annually. Despite the export volume of styrax resin reached 5,541 kg with a value of US$ 96,900, imports of end products in the form of beauty products in 2008 reached US$ 401 million [2,3].

Recently, efforts to increase the value-added of resin processing are growing. This resin has been processed by different distillation techniques to yield some distinct products including essential oil, hydrosol, distilled biomass, residual water and ashes [2-4]. However, these distilled products have not been developed into innovative organic personal care products.

The pandemic Covid-19 rises global awareness to improve the body's immune system through utilization of healthy products from good quality green products. One of personal care products that are much needed during the pandemic is hand washing soap. Unfortunately, almost all cosmetic and healthy products use synthetic fragrances and ingredient, while limited cosmetic’s manufacturers use essential oils to produce high quality products.
Various studies have shown that incense resin contains phyto-chemical content which is important both as antiviral, anti-septic with a relaxing aroma [5-9]. Incense oil can also be used for skin beauty. Considering these multiple benefits, incense resin is considered prospective to be used as raw material for healthy and beauty soaps.

The objective of study is to initiate the distilled styrax resins utilization into personal care and cosmetics products in form of green and organic soaps. The development of personal care products made from incense oil is expected to increase the value-added of incense resin processing. Therefore these innovative products will reduce dependence on imports of incense-based beauty and health products.

2. Methods

2.1. Materials
The styrax essential oil used as major raw materials in the soap formulations. Organic oils and compound were also applied, such as palm oil, olive oil, coconut oil, shea butter, bees wax, lauric acid, myristic acid and castor oil. Some reagents were used, namely sodium chloride (NaCl), sodium hydroxide (NaOH, pellets) and ethanol (C₂H₅OH).

2.2. Styrax essential oil extraction
The styrax essential oil was extracted in two ways. The styrax oils were extracted using ethanol solvent with a ratio of 1: 1 (w/w). Furthermore, the solvent is removed by a rotary evaporator. This method has been applied in various related research [2-5].

2.3. Saponification
Saponification reaction is alkaline hydrolysis of triacylglycerols, also known as cold process for making soap. In aqueous medium, the oils react with sodium hydroxide to produce the sodium salts of hydrolysed free fatty acids (soap) and glycerine or glycerol [9-12]. The stages begin with weighing various oils in beakers based on different formulations as shown in Table 1a and 1b. The formulation begins by heating a total of 30 g oils from various constituents at low temperature (37°C) for homogenization. Next, 4 g of sodium hydroxide pellets were dissolved in hydrosol (distilled water), then the solution was added gradually to homogeneous oils mixture. The mixture was stirred until thickened. The homogeneous mixtures were put into soap molds, followed by drying at room temperature for at least 48 hours before being disassembled. At the end of process, the soaps required maturation stage for two weeks [9]

Table 1a. Oils and ingredients used in various formulations.

| Formulation | Palm oil (g) | Olive oil (g) | Coconut oil (g) | Shea butter (g) | Bees wax (g) | Lauric acid (g) | Myristic acid (g) | Castor oil (g) |
|-------------|--------------|---------------|-----------------|-----------------|--------------|----------------|------------------|----------------|
| 1           | 6.0(20)      | 6.0(20)       | 6 (20)          | 4.5(15)         | 1.5(5)       | 6.0(20)        | -                | -              |
| 2           | 6.0(20)      | 6.0(20)       | 6 (20)          | 4.5(15)         | 1.5(5)       | 6.0(20)        | 3.0(10)          | -              |
| 3           | 6.0(20)      | 4.5(15)       | 4.5(15)         | 4.5(15)         | 1.5(5)       | 6.0(20)        | 3.0(10)          | -              |
| 4           | 6.0(20)      | 4.5(15)       | 4.5(15)         | 4.5(15)         | 1.5(5)       | 6.0(20)        | 3.0(10)          | -              |
| 5           | 6.0(20)      | 6.0(20)       | 4.5(15)         | 3.0(10)         | 1.5(5)       | 6.0(20)        | 3.0(10)          | -              |
| 6           | 6.0(20)      | 6.0(20)       | 4.5(15)         | 3.0(10)         | 1.5(5)       | 6.0(20)        | 3.0(10)          | -              |
| 7           | 6.0(20)      | 7.5(25)       | 4.5(15)         | 3.0(10)         | 1.5(5)       | 4.5(15)        | 3.0(10)          | -              |
| 8           | 6.0(20)      | 7.5(25)       | 4.5(15)         | 3.0(10)         | 1.5(5)       | 4.5(15)        | 3.0(10)          | -              |
| 9           | 4.5(15)      | 4.5(15)       | 4.5(15)         | 3.0(10)         | 1.5(5)       | 6.0(20)        | 1.5(5)           | 4.5 (15)       |
| 10          | 4.5(15)      | 4.5(15)       | 4.5(15)         | 3.0(10)         | 1.5(5)       | 6.0(20)        | 1.5(5)           | 4.5 (15)       |

Note: *the formulation were assisted by SOAPCALC application
Table 1b. Oils and ingredients used in various formulations (Continue).

| Formulation | Styrax EO (ml) | NaOH (g) | Water as % oils |
|-------------|----------------|----------|-----------------|
| 1           | 0.5            | 4        | 25              |
| 2           | 1.0            | 4        | 25              |
| 3           | 0.5            | 4        | 25              |
| 4           | 1.0            | 4        | 25              |
| 5           | 0.5            | 4        | 25              |
| 6           | 1.0            | 4        | 25              |
| 7           | 0.5            | 4        | 25              |
| 8           | 1.0            | 4        | 25              |
| 9           | 0.5            | 4        | 25              |
| 10          | 1.0            | 4        | 25              |

Note: *the formulation were assisted by SOAPCALC application*

Soap profiles on different formulation included hardness, cleansing and performance, bubbly and creamy formation, iodine content and aroma. The value of each profile is determined according to the Likert scale (five scale options with format very high; high; medium; low; very low). The number of each soap profile also obtained based on the SOAPCALC application which is run online [13].

2.4. Soap evaluation
An anonymous survey was conducted in order to evaluate the soap’s acceptance. The forty respondents were selected asked about their expressions of the tested soap (sensation after washing, soap profiles includes cleansing performance, foam formation, sensibility, moisture, smoothness, aroma, and willingness to continue using). All respondent used the soap for washing hand for two consecutive days.

3. Results and discussion

3.1. Soap formulations
Soap profiles from different formulations were evaluated in order to determine the best composition of oils constituent. Some of soap profiles assessed included the hardness, cleansing power, conditioning, bubbly, creamy and iodine each obtained soap (Table 2).

Soaps with formulations #1 and #2 are prepared from various oils with the composition of palm oil (20%), olive oil (20%), coconut oil (20%), shea butter (15%), lauric acid (20%) and added with 0.5% and 1.0% of styrax essential oil as a fragrant additive to the constituent of soap ingredients. The resulting soaps were relatively harsh, faded color and presented an unpleasant aroma. The medium hardness level is due to the sufficient beeswax and stearic acid content (Table 3). Stearic acid is commonly used in soap production as an additive to harden the texture, give it a pearl white color, and make it easy to rinse off (a coarse sensation on hand) [9,11,12]. Despite improving the cleansing performance, the coconut oil content produces an unpleasant odor.

The formulations #3 and #4 have the same constituents as the first two formulations but with different concentrations. The olive oil concentration was increased to 20%, but concentration of shea butter was reduced to 10%. These formulations produced nice soap with right consistency, higher cleansing power with pleasant texture and aroma. The hardness profile with easy rinse is influenced by stearic acid content contained (Table 3). These compounds are also widely applied to transform product’s consistency or melting temperature and prevent the oxidation [9,11,12].

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Next, formulation #5 and #6 also have the same constituents as the previous four formulas. Compared to formulation #3 and #4, the olive oil concentration was increased to 20% but shea butter concentration was reduced to 10%. These formulations produce soaps with higher cleansing power with more bubble foam. This good cleansing ability is due to sufficient of lauric acid content (Table 3). Lauric acid found in palm kernel oil and coconuts oil, is a medium-chain triglyceride or medium-chain fatty acid [14]. This
compound has strong antimicrobial properties and better anti-inflammatory performance for sensitive skins.

Table 2. Soap profiles on different formulations.

| Profiles   | Formulation |
|------------|-------------|
|            | #1 | #2 | #3 | #4 | #5 | #6 | #7 | #8 | #9 | #10 |
| Hardness   | ++++ (70) | +++ (74) | +++ (72) | +++ (68) | +++ (63) |
| Cleansing  | +++ (53) | +++ (58) | +++ (58) | +++ (53) | +++ (50) |
| Conditioning | +++ (31) | ++ (27) | ++ (28) | ++ (32) | ++ (38) |
| Bubbly     | +++ (53) | +++ (58) | +++ (58) | +++ (53) | +++ (63) |
| Creamy     | + (15) | + (14) | + (12) | + (13) | ++ (25) |
| Iodine     | ++ (31) | ++ (26) | ++ (28) | ++ (32) | ++ (35) |
| Aroma      | ++ | ++ | +++ | +++ | +++ | +++ | +++ | +++ | +++ |

*a++++ very high; +++ high; +++ medium, ++ low, + very low (Likert scale)

b(number) obtained based on the SOAPCALC application [12]

Despite the soap hardness is lower, formulation #7 and #8 produced a soap with gentler sensation on the hands. This is due to the higher conditioning agent content. This hand-softening performance was investigated due to its sufficient myristic acid and palmitic acid content (Table 3). The acid from *Myristica fragrans* oils have moisturizing properties, so it is very good for maintaining skin's moisture, especially dry and scaly skin. In addition, this compound is able to absorb oil excess and dirt on skin, so it commonly used in beauty industry as face wash or bath soap component. While, palmitic acid is an anti-oxidant which also contains omega-7 fatty acids, which useful for healing wounds, including treating burns. The acid produced from palmae plants is also rich in vitamins E and C which can help prevent fine wrinkles on e face as well as smooth the skin. Regular use can increase skin cell rejuvenation and reduce dermatitis and eczema.

The last, formulation #9 and #10 produce soaps with medium hardness, more bubble foam and good cleaning power and moisturizing. There is the addition of a new constituent compound, castor oil in formulations #9 and #10. These oils rich with ricinoleic acid which it can help treat the acne problems caused by bacteria.

Overall, the soaps produced from a variety of different formulas contain sufficient oleic, linoleic, palmitic, stearic, and lauric acids (Table 3). Considering soaps were produced from a different oil formulation, the phytochemical compounds contained are also different. Several phytochemical compounds identified are presented in Table 3.

Table 3. Phytochemical compounds identified in various soap formulations.

| Compounds | 1-2 | 3-4 | 5-6 | 7-8 | 9-10 |
|-----------|-----|-----|-----|-----|-----|
| Lauric    | + (4) | + (13) | + (13) | + (13) | + (6) |
| Myristic  | + (5) | + (4) | + (5) | + (6) | + (4) |
| Palmitic  | + (7) | + (7) | + (5) | + (5) | + (5) |
| Stearic   | + (0) | + (0) | + (0) | + (0) | + (14) |
| Oleic     | + (24) | + (21) | + (22) | + (25) | + (18) |
| Linoleic  | + (4) | + (3) | + (4) | + (4) | + (3) |

Oleic acid is most popular acids for dry and normal skin types. The omega-9 content in oleic acid has the benefit for improving skin texture by providing moisture that can be absorbed quite quickly [15]. Basically, the body needs linoleic acid as an ingredient for ceramides which are both protective and moisture-keeping for the skin. Therefore, a body that is deficient in linoleic acid can experience a
number of impacts, from dryness of the skin, easy hair loss, slower wound recovery, to decreased cell regeneration. Some studies also state that people with acne-prone skin tend to have low levels of linoleic acid [15,16]. Linoleic acid also has a lightweight texture, which means that it is well absorbed by the skin while helping to maximize the absorption of other skin care ingredients [16].

Although formulations #3, #4, #5 and #6 were highlighted by their good cleansing performance, formulation #7, #8, #9 and #10 were considered by consumer, due to its conditioning ability and produced more bubble foam. But, the amount of olive oil utilization in formulation #7 and #8 conducted the longer maturation process. Furthermore, formulations #9 and #10 were considered present a balance composition and better profiles in terms of production costs, maturation process, washability, rinseability, smoothness, and skin hydration.

| Compound        | Amount (%) | Odor/ Benefits                                                                 |
|-----------------|------------|-------------------------------------------------------------------------------|
| Styrene         | 2.3        | Evaporates easily, sweet and pleasant smell                                  |
| Benzaldehyde    | 0.9        | Colorless, almond like odor                                                  |
| 1,8-cineole     | 0.4        | Correlates with rosemary essential oil aroma                                |
| Acetophenone    | 1.0        | Colorless liquid with a sweet pungent taste, oranges odor, floral odor and an powdery flavor. |
| Methyl benzoate | 0.5        | Pleasant smell, strongly reminiscent of the fruit                           |
| Benzoic acid    | 1.7        | Pleasant odor. It is used, in perfumes and flavorings, and as a food preservative and anti-fungal agent |
| Ethyl benzoate  | 0.9        | Pleasant odor, fruit flavors                                                  |
| (E)-cinnamaldehyde | 0.7    | Cinnamomun odor and flavor                                                    |
| Allyl benzoate  | 0.9        | Sweet, slightly pungent, floral                                               |
| Propyl benzoate | 0.1        | Balsamic odor and an fruity flavor                                             |
| Ethylguaiaicol  | 0.6        | Colorless to slightly yellow liquid with strong odor and distinctive aroma of soybeans. |
| Eugenol         | 0.8        | Powerful, warm-spicy, rather dry and almost sharp odor                        |
| Cinnamic acid   | 3.5        | A honey-like odor                                                            |
| Trans-α-bergamotene | 0.2  | Woody odor                                                                   |
| Ethyl cinnamate | 0.1        | Fruity and balsamic odor, reminiscent of cinnamon with amber note            |
| Allyl cinnamate | 0.5        | Colorless to light yellow colored liquid of cherry odor                        |
| (E)-nerolidol   | 0.4        | Balsamic odor                                                                |
| Isobutyl cinnamate | 0.1    | Balsamic odor and flavor                                                     |
| Benzyl benzoate | 76.1       | Sweet-balsamic odor                                                          |
| Cinnamyl benzoate | 1.4     | Balsamic odor and flavor                                                     |
| Benzyl cinnamate | 3.3        | Balsamic odor and spicy flavor                                               |
| (E)-cinnamyl-(E)-cinnamate | 0.9 | Fruity balsamic, pineapple spicy flavor                                      |

Note: *[5]

Despite limited influence in saponification effectiveness, the addition of styxar essential oil enhanced the soap aroma. This is due to the essential oil contains various volatile compounds which have a fragrant aroma [5-7]. Chemical composition of volatile extracts of styxar essential oil along with their aroma is shown in Table 4.

For aromatherapy application, styxar essential oil aroma has a relaxing effect [6,7,17,18]. In topical application, styxar oil can relieve inflammation, insect bites, acne, itching, irritation, rashes, sprains, and muscular aches and pains [5-7]. The compound 1,8 cineole has potential as anti-viral, anti-bacterial and
anti-fungal, expectorant, offer relief to a congested respiratory system by clearing the lungs, thereby boosts circulation and body’s immune system [7].

3.2. Soap evaluation
The soap produced by formulation #10 was tested to evaluate soap acceptability through an anonymous survey of forty respondents. The respondents which over 17 years old were asked about their expression on tested soap after two consecutive days utilization (Table 5).

Table 5. Respondents’ expressions of the tested soap.

| Criteria                  | Untolerable (Low) | Tolerable (medium) | Pleasant (high) |
|---------------------------|-------------------|--------------------|-----------------|
| Sensation after washing   | 2 (5.0%)          | 7 (17.5%)          | 31 (77.5%)      |
| Cleansing                 | 4 (10.0%)         | 12 (30.0%)         | 24 (60.0%)      |
| Foam formation            | 4 (10.0%)         | 14 (35.0%)         | 22 (55.0%)      |
| Sensibility               | 5 (12.5%)         | 15 (37.5%)         | 20 (50.0%)      |
| Moisture                  | 3 (7.5%)          | 14 (35.0%)         | 23 (57.5%)      |
| Smoothness                | 3 (7.5%)          | 14 (35.0%)         | 23 (57.5%)      |
| Aroma (scent)             | 3 (7.5%)          | 11 (27.5%)         | 26 (65.0%)      |
| willingness to continue using | 2 (5.0%)       | 7 (17.5%)          | 31 (77.5%)      |

Most respondents (77.5%) expressed their willingness to continue using the product, pointing up the pleasant sensation after washing hand (Table 5). This is due to the high cleansing ability, lots of foam, soft and moist sensation in the hands, and a pleasant odor. The soap with styrax essential oil aroma was a new experience for all respondents.

Considering the foam formation, most respondents (55.0%) expressed their satisfaction with foam produced, while 14 respondents (35.0%) assessed that soap produces sufficient foam. Only four respondents (10.0%) assumed that soap only produces limited or insufficient foam. Twenty-six respondents (65.0%) rated the tested soap presented a pleasant aroma and eleven respondents (27.5%) considered the aroma as acceptable. Only three respondents (7.5%) referred to the unpleasant smell.

3.3. Soap production costs

Table 6. Soap production costs.

| Product/ Ingredient | Packaging | Unit price (IDR x000) | Used amount (g) | Real cost (IDR) |
|---------------------|-----------|-----------------------|-----------------|-----------------|
| Palm kernel oil     | 905.6 g   | 1,061                 | 4.5             | 5,272           |
| Olive oil           | 1000 g    | 135                   | 4.5             | 608             |
| Coconut oil         | 1000 g    | 150                   | 4.5             | 675             |
| Shea butter         | 1000 g    | 200                   | 3.0             | 600             |
| Beeswax             | 1000 g    | 135                   | 1.5             | 203             |
| Lauric acid         | 1000 g    | 62                    | 6.0             | 372             |
| Myristic acid       | 1000 g    | 57                    | 1.5             | 86              |
| Castor oil          | 100 mL    | 208                   | 4.5             | 9,360           |
| Styrax EO           | 10 mL     | 72                    | 2               | 1,440           |
| Sodium hydroxide    | 1 kg      | 600                   | 75              | 2,400           |
| Ingredients cost    |           |                       |                 | 21,015          |
| Energy (30% of ingredients) |       |                       |                 | 6,304           |
| Total               |           |                       |                 | 48,334          |
Table 6 shows the estimated costs of soap production based on formulation #10. Production costs consist of supplying various oils, ingredients and energy (assuming 30% of ingredient cost). The total production cost was calculated around IDR 48,334 for 60 pieces of soap production, which means that each soap costs around IDR 805.56. In this case, the labour cost was unconsidered.

Recently, health and cosmetic soaps with pleasant scents become the consumer's preferences. Unfortunately, this quality product more expensive, consequences their market acceptance is limited. On the other hand, the study shows that soap production use styrrx oil, palm oil and coconut oil which relatively abundant in Indonesia, a good quality organic product but cheaper can be produced.

4. Conclusions
The application of styrrx essential oil, apart from overcoming the unpleasant aroma presented by another oils, also act as a fixative agent. This natural fragrance increases the consumer’s acceptance. Most of respondent (87.5%) expressed their pleasure, related to good sensation after washing hand using the innovation soap. The results showed the idea of processing styrrx resin into a healthy personal care product is highly feasible for wide-scale application. Regarding the product contains organic ingredients, it is considered healthier and better for skin treatment, and finally supports the local economy development.

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