Physical Properties of Turpentine and Gum Rosin *Pinus merkusii* Jungh et de Vriese Tapped Oleoresin by Borehole Method

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Abstract

This study was conducted to determine the physical properties of turpentine and gum rosin derived from oleoresin tapped with borehole method. The research material is derived oleoresin from Aceh provenance pine and Jember landrace. The test results of the physical properties of turpentine are as follows; color: clear, specific gravity 0.84-0.85, refraction index 1.46, negative fatty oil, flash point 34-35.5°C, residual evaporation 1.2-1.6%, and optical round + 32.2-32.4^{o}. Result of test of physical properties of gum rosin: color X (main), softening point 76.0-76.5°C, impurity 0.0014-0.0051%, acid value 179.5-188.5, saponification value 188.7-194.3, iodine number 9.6-9.8, ash content 0.001-0.005% and volatile tupentine content 2.1-2.4%.

Keywords: Aceh provenance pine, borehole method, gum rosin, turpentine.

INTRODUCTION

Pinus merkusii is one of the native tree species of Indonesia with its natural distribution in Aceh, Tapanuli and Kerinci. The products of pine oleoresin are gum rosin and turpentine. Gum rosin and turpentine export opportunities are still wide open because the world's largest producer is dominated by three countries, Cina, Brazil and Indonesia. Indonesia's gum rosin and turpentine export markets are India, the United States, France, Cameroon, and the Netherlands which they are only able to meet less than 10% of the market demand [1].

According to Langenheim, the use of turpentine is limited only as a paint thinner, whose economic value is low [2]. Currently, turpentine benefits are becoming more important for the chemical industry, if it is in the form of its derivatives. The mixture between alpha pinene and beta pinene contained within the turpentine is required as a glue, transparent tape and similar products. Insecticides and bactericides require alpha pinene and champena. The current widespread use is as a raw material for synthetic fragrances such as orange flavor, menthol, nutmeg flavor, deodorant and cooling effect of cosmetics (lipstick). Gum rosin is traditionally required by the *batik*, soap and paper industries, today more widely used such as plaster softeners and dental dressing mixtures, eyeshadow blends and eyelash reinforcement, adhesives, colors in the printing industry (ink) and paint [4].

Physical properties of turpentine-gum rosin related to the quality of these products and affect the sale value. Physical properties are also related to technical processing and raw materials. The physical properties of a product must meet the quality requirements of the established quality standard. Until now, the processing of the oleoresin becomes turpentine and gum rosin is produced by the gum rosin and turpentine processing factory, whose raw material comes from tapping the quare method, and the resulting oleoresin is mixed with various impurities. In this research, the oleoresin was obtained by tapping the borehole method on Aceh provenance pine and Jember landrace. The purpose of this research is to know the difference of physical properties of turpentine and gum rosin Aceh provenance pine and Jember landrace.

MATERIALS AND METHODS

Location and Time of Research

Oleoresin material obtained from the tapping of Aceh provenance pine in the Seedling Seeds Orchard, Sumberjati Forest Management Resort (*Resort Pemangkuan Hutan* – RPH), Sempolan Sub Unit of Forest Management (*Bagian Kesatuan Pemangkuan Hutan* – BKPH), Jember Unit of Forest Management (*Kesatuan Pemangkuan Hutan* – KPH). The Jember landrace oleoresin is obtained from pine tapping of the plants in Plot 21e, RPH Garahan, BKPH Sempolan KPH Jember.

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Tools and Objects

The tool used consists of mini distillers capacity of 1.5 kg. Objects of the study are Aceh provenance pine and Jember landrace.

Tapping the Oleoresin

Oleoresin tapping with borehole method were done by following step. The oleoresin that directly comes out of the tree in the container were put into the plastic bag and accommodated in a plastic container. Oleoresin required as much as 6 kg, for four times cooking (replication).

Cooking of Oleoresin

Cooking oleoresin with temperature 160-180^{o}C for 2 hours. Turpentine that comes out in the glass were measured and gum rosin accommodated in a place made of zinc size 17 x 14 x 9 cm.

Test the Physical Properties of Turpentine

The physical properties of turpentine were tested according to SNI 01-5009.12-2001 standard in Non-Timber Forest Product Laboratory of Perum Perhutani Divre I Semarang, covering test specifications: Specific weight at 25^{o}C, Refraction Index at 25^{o}C, Oil and Fat, Evaporation Time, Color visually and Optical Rounds.

Test the Physical Properties of Gum Rosin

Physical properties of gum rosin are tested according to SNI 01-5009.12-2001 consisting of color, softening point, impurity, acid value, saponification value, iodine value, ash content of Heraeus Furnace method and the remaining volumes of oil content (volatile oil content). Physical properties test is conducted in Laboratory Non-Timber Forest Product Perum Perhutani Divre I Semarang.

Data Analysis

The results of the laboratory test of the physical properties of gum rosin-turpentine are then analyzed in a descriptive manner.

RESULT AND DISCUSSION

Physical Properties of Turpentine

The physical properties of turpentine are influenced by the production process and raw materials (oleoresin). The production process with raw materials mixed with other ingredients such as leaves, skin flakes, soil, water and other mixtures, requires a gradual cleaning process until the production of Oil Pine Resin (OPR) is ready for cooking. This is done at a oleoresin processing plant. According to Sukarno [8], clean raw materials, tapping oleoresin with borehole method, oleoresin cooking can be done without going through the process of cleaning the oleoresin material. The production process in the factory, both the tool and the operating procedure, has followed the established standards and has obtained ISO-9001-2008 certification.

In this research, the processing of oleoresin is still using the old way of direct heating, the difference is not using a fire heater but with an electric heater. The reason for using direct heating means is to simplify the tool, but without reducing the function as a destilator. The raw materials are considered good because of the oleoresin result of tapping with the borehole [9].

The physical properties of turpentine have been tested with SNI 01-5009.12-2001 standard. Table 1 shows that of the seven specifications tested, the physical properties of the Aceh provenance pine turpentine and the Jember landrace have met the standards required by SNI 01-5009.12-2001. The resulting density ranges from 0.85. Specific gravity is the weight ratio of an object with the same weight of water at the same temperature, so that the volume of 1 liter turpentine weighs equal to 0.85 kg. Refractive index at 25°C. We did not found fatty oil content (negative results).

Table 1. The Results of physical properties on Turpentine of Aceh and Jember Pine

Specifications test	Standard	Aceh			Jember
	SNI 01-5009.12-2001	Takengon	Blangkejeren	Jantho	
Specific gravity on 25°C	0.848 – 0.865	0.857	0.857	0.857	0.858
Refraction index on 25°C	1.464 – 1.478	1.465	1.465	1.465	1.465
Fatty oil	Negative	Negative	Negative	Negative	Negative
Flash point	33°C – 38°C	34.0°C	35.5°C	35.2°C	35.0°C
Residual evaporation	Grade A: ≤ 2% Grade B : > 2%	1.50%	1.18%	1.44%	1.58%
Color	Clear	Clear	Clear	Clear	Clear
Optical round	Grade A : +≥ 3° Grade B : +<3°	+ 32.38°	+ 32.37°	+ 32.32°	+ 32.33°

Notes: Analysis in Laboratory of Non Timber Forest Products, Industrial Perum Perhutani Divre I Semarang in 2011

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Flashpoint on the turbulent in Takengon shows the numbers below the turbulent Blangkejeren, Jantho and Jember landrace, but still above the required minimum. The remainder of evaporation and optical rotation are included in the quality criteria A (excellent quality). Clear turpentine color, meaning turpentine is not oxidized or not mixed with water, optical rotation including A (prime) quality. Although the production process using a simple tool, but the results are in accordance with the required standard.

Physical Properties of Gum Rosin

Color

The quality of gum rosin first used as an indicator is color, because this physical nature is the visible first impression. If the color shown the criteria that have been set, it will affect the price and attractiveness for consumers. The color of gum rosin in SNI-01-5009.4.2001 is classified as: Main (color X); First (color WW); Second (color WG) and third (color N). The X = Extra (Rec) gum rosin clear color of yellowish; WW = water white, yellow; WG = the glass window is brownish yellow and N = Nancy is brownish, based on the color standard through the Lovibond tool. Color is determined by the raw materials and the production process. The gum rosin and turpentine processing factory (PGT) obtained raw materials, derived from tapping oleoresin through quare method which oleoresin mixed with various impurities.

In this study, the raw material comes from tapping with borehole method, so that the impurities mixed in the oleoresin can be minimized. Oleoresin directly cooked without going through the process of cleaning dirt and dilution sap. Given the very simple tool (mini-scale), it still raises quality color of two opposite choices, if the color is good, then the softening point is less than the standard. The results of physical properties of gum rosin presented in Table 2.

Table 2. The Results of physical properties on Gum Rosin of Aceh and Jember Pine

Specifications test	Standard SNI 01-5009.12-2001	Aceh Provenance			Jember
		Takengon	Blangkejeren	Jantho	
Color	X/WW/WG/N	X	X	X	X
Softening Point	X = ≥ 78°C WW = ≥ 78°C WG = ≥ 76°C N = ≥ 74°C	76.5°C	76.5°C	76.0°C	76.0°C
Impurity	X= ≤ 0.02 % W = ≤ 0.05% WG = ≤ 0.07% N = ≤ 0.10%	0.0014%	0.0036%	0.0040%	0.0051%
Acid Value	160 – 190	179.46	183.62	188.50	182.06
Saponification value	170 – 220	188.72	190.49	194.27	191.87
Iodine Value	5 – 25	9.68	9.78	9.61	9.70
Ash Content	X = ≤ 0.01 % WW= ≤ 0.04 % WG= ≤ 0.05 % N = ≤ 0.08 %	0.0013%	0.0046%	0.0030%	0.0043%
The volatile turpentine contents	X = ≤ 2 % WW = ≤ 2 % WG = ≤ 2.5 % N= ≤ 3 %	2.365%	2.168%	2.122%	2.212%

Notes: Analysis in Laboratory of Non Timber Forest Products, Industrial Perum Perhutani Divre I Semarang in 2011.
X= Rex, WW= Water White, WG= Windows Glass, N= Nancy

Table 2 showed that the color of gum rosin produced shows the main color (U) that is extra color (X), this is suspected because the raw material of the oleoresin is derived from tapping by borehole method, so it is a clean raw material. This is as delivered by Wiyono that the raw material is very decisive to the color of gum rosin [5]. The quality of gum rosin produced is determined by the quality of the processed oleoresin [6]. Fresh oleoresin will produce better quality gum rosin compared with that derived from oleoresin that has been stored for long, let alone stored in open space, causing the oleoresin to be oxidized [5]. Pine oleoresin is a complex compound that is acidic and very sensitive to time and damage due. The cooking process also greatly determines the color of gum rosin, especially the temperature setting and the length

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of the cooking time. In practice, people are often more interested in paying attention to color first, although not always, color reflects the quality of others [7].

Soft Point

The soft point is closely related to the remaining turpentine in gum rosin, the less the remaining turpentine, the higher the soft point and vice versa. Gum rosin with turpentine content is still remaining much, then the gum rosin will be less fragile (crumb), according to SNI standard, the required softening point is ≥ 78°C. The result of physical properties test in laboratory (Table 2) shows soft point of gum rosin from Aceh provenance pine (Takengon and Blangkejeren) 76.5°C, while Jantho and Jember landrace 76°C, so based on SNI standard soft point is still less 1.5 - 2°C . Physically, the soft spot between 76-76.5°C gum rosin looks no different, hard (not flabby), brittle (crumb), so it still meets the required physical quality standards. This is in accordance with the opinion of Khadafi et al., that good quality gum rosin according to the consumer is not easy to soften at room temperature, brittle (fragile) and does not change physically from time to time (during storage) [7].

Average gum rosin droppings produced by PGT. Rejowinagun (direct interview with head of the factory, 2010) is 0.0229% has met the standard set by the SNI that is the lowest ≤ 0.02%. This is because the process of cleaning the oleoresin from the dirt has been done through several stages of filtering and washing oleoresin. The results when compared with the factory, it shows a much lower result that is Takengon 0.0014%, Blangkejeren 0.0036%, Jantho 0.0040% and Jember landrace 0.0051%. This suggests that tapping the oleoresin by borehole will produce gum rosin with very low levels of impurities.

CONCLUSION

Based on the test results of physical properties of turpentine and gum rosin, both Aceh provenance pine and Jember landrace has similar physical properties. The physical properties of the turpentine of the seven specifications tested have shown the range of numbers required under SNI 01-5009.12-2001. Meanwhile, the physical properties of gum rosin of the eight specifications tested have also shown the range of numbers required under SNI 01-5009.12-2001. Therefore, the borehole method produce a clean oleoresin and has less damage towards the pine trees to meet the standard.

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REFERENCES

[1] State Forest Enterprise. 2011. Industri Gondorukem dan Terpentin Perum Perhutani. Laboratory of Industry and Marekting Bureau. Perum Perhutani Unit I Jawa Tengah.

[2] Langenheim, J.H. 2003. Plant Resin: chemistry, evolution, ecology and ethnobotany. Timber Press. Cambridge.

[3] Lenny, S. 2006. Senyawa Terpenoida dan Steroid. Sciantific Paper. Faculty of Mathematics and Naturan Sciences. University of North Sumatera.

[4] [Sjostrom, E. 1998. Kimia Kayu: dasar-dasar dan penggunaannya, 2nd Ed. Hardjono Sastrohamidjojo, H. (Transl). Gadjah Mada University Press. Yogyakarta.

[5] Wiyono, B. 2007. Pengaruh konsentrasi bahan kimia maleat anhidrida terhadap gondorukem maleat dari getah *Pinus merkusii*. *Jurnal Penelitian Hasil Hutan.* 25. (1). 28-40.

[6] Nasnedi, B.D., A.F. Mas'ud (Eds). 2001. Kajian teknis ekonomis pengolahan gondorukem dalam rangka peningkatan nilai tambah: studi kasus di PGT Peninggaran dan PGT Cimanggu. Center of Forestry Research and Development. Department of Foretsry.

[7] Khadafi, M., I. Rostika, T. Hidayat. 2014. Pengolahan gondorukem menjadi bahan pendarihan sebagai aditif pada pembuatan kertas. *Jurnal Selulosa.* 4(1). 17-24.

[8] Sukarno, A., E.B. Hardiyanto, S.N. Marsoem, M. Na'iem. 2012. Pengaruh perbedaan kelas umur terhadap produktivitas getah *Pinus merkusii* Jungh et de Vriese ras lahan Jawa melalui penyadapan getah metode bor. *Jurnal Pembangunan dan Alam Lestari.* 3(1). 28-31.

[9] Sukarno A., E.B. Hardiyanto, S.N. Marsoem, M. Na'iem. 2015. Oleoresin production, turpentine yield and components of *Pinus merkusii* from various Indonesian Provenances. *J. Trop. Forest Sci.* 27(1). 136-141.

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