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Ethnic uses of pine resin production from *Pinus brutia* by native people on the Kazdağ Mountain (Mt. Ida) in Western Turkey

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Abstract

The Turkish red pine (*Pinus brutia* Ten.) forests are the most suitable forests of Turkey for the pine resin production by tapping, because of the conditions for both topography and climate of distribution area of these species. Named as the 'pine oleoresin', 'gum turpentine' or 'terpenes oil'; is the term 'essential oil of turpentine' which designates the terpenic oil, obtained by hydrodistillation of the pine resin. Pine resin constitutes the raw material of the traditional Turkish drugs. It is produced from barks of *Pinus brutia*, that grows naturally in various regions of Turkey. In this review, traditional production of pine resin by local people in Western Turkey, its chemical properties and effects on health were explained. It is also determined that pine resin has an effective role in prevention of some diseases. The survey was carried out in 2 towns and 14 villages where the *P. brutia* has large population. Pine resin was collected from the mentioned fields, along with the information regarding local names, usage, sorting and grading methods obtained questioning the local people. Production of pine resin is an important source of income for people in local region. Pine resin is gathered directly by the local villagers, especially, unemployed people with financial difficulties. Also, threat factors and solution for long-term conservation of the pine resin production were also determined in this study. Major constituents of the pine resin were α-pinene, β-pinene, Δ3-carene, camphene, limonene, myrtenol and caryophyllene oxide.

Key words: Ethnobotany, *Pinus brutia*, pine resin, Turkey.

Introduction

Pinus brutia Ten. is named as 'Kızılçam' in Turkish corresponding to the word 'red pine' in English, which is because of its reddish young sprouts [1]. Red pine is also known by several other names, Turkish pine, Calabrian pine (from a naturalized population of the pine in Calabria, Southern Italy, from where the pine was first botanically described), East Mediterranean pine and Brutia pine [2]. The Turkish red pine forests in Turkey are found in the Mediterranean, Aegean and Marmara regions, mainly coastal areas. The species are also important for Turkish forestry and forest products; especially, the resin obtained from *Pinus brutia* is an important non-wood forest product in Turkey. The red pine forests are the most suitable forests of Turkey for the pine resin production, because of the conditions for both topography and climate of distribution area of these species [3].

Resin seals the plant's wounds, kills insects and fungi, allows plant to eliminate excess metabolites and it is used as varnish and adhesive [4]. Pine resin is traditionally obtained by tapping the bark (bark chipping) of the pine tree and collection of the resulting exudate. Resin tapping system was started in the fifteenth century as a Noval stores industries in America. American used resin for sealing the crack or hole in the boat [5]. Complex mixtures of acidic and neutral diterpenes, together with a more or less important fraction of volatile compounds (mono- and sesquiterpenes), compose the oleoresins. Steam distillation is used in the industry to convert by steam distillation into gum turpentine (volatile compounds) and gum rosin (diterpenes) [6, 7].

Turpentine (also called spirit of turpentine, oil of turpentine and wood turpentine) is a fluid obtained by the distillation of resin obtained from trees, mainly pine trees. Turpentine can be used in many areas of industry such as medicine, pharmacy, food, cosmetics, paint and coatings, automotive and weapon industry *etc.* [6-8]. Consequently, the production of resins and turpentine is economically and strategically important product of pine species, grown naturally in Turkey. This should be encouraged since it helps, eventually, local people by economical means. The aim ofn this study was to explain the production and use of pine resin obtained from bark of *P. brutia* by native people on the Kazdağ (Mt. Ida) in Western Turkey.

Materials and Methods

P. brutia is distributed in the southern and western Turkey. It can be seen from sea level to 600 m and up to 1500 m in the southern parts. The study was carried out at sea level to 400 m on Edremit Gulf in West Anatolia in 2 towns (Edremit and Burhaniye) and 14 villages (Avcılar, Beyobası, Dereli, Karadere, Kavlatlar, Kırtık, Kızıklı, Kuyumcu, Mehmetalan Sübeylidere, Şahinler, Pelitköy, Yaşyer and Tahtacı) where *P. brutia* has large population.

The ethnobotanical information and illustrations presented in

this study were collected in 2009-2010 through visits, interviews, and observations of the villagers around Kazdağ Mountain (Mt. Ida). Local names of pine resin, usage, sorting, grading and production methods were resources taken at local market places around Kazdağ.

Results and Discussion

Traditional pine resin production: Stages of traditional pine resin production are schematically presented in Fig. 1. This traditional method consists of 5 stages: obtaining raw material, boiling and melting, filtering, cooling and forming, packing and selling (using).

Obtaining raw material
⇓
Boiling and melting
⇓
Filtering
⇓
Cooling and forming
⇓
Packing and selling (using)

Figure 1. Traditional pine resin production process.

Gathering and obtaining of the raw materials used for pine resin: The raw material used for pine resin is obtained from *P. brutia*. It is named as 'Sorkuç' in Turkish.

Generally, gathering period of resin is between May and September. The resin is gathered directly by the local people, especially, unemployed people with financial difficulties. However, the gathering of plants was exclusively men's work. They use a knife for gathering pine resin from tree and a basket for carrying the gathered resin. Resin is obtained by tapping the tree, making a cut, which expose the surface of the wood. When a cut as a 'V' shape is opened on the trunk of *P. brutia*, the resin begins to flow out and begins to thicken with contact to air within 5-10 min and it must be collected immediately. In accordance with the age and the trunk diameter of the tree, an approximate of 50-200 g of resin can be received per tree (Fig. 2 A-B).

Boiling and melting: The total raw material collected in a kilned jug is boiled approximately for 4-5 hours depending on the degree of the fire. As it needs a strong fire to boil, wood is used. It has to be stirred with a wooden spoon till the resin is thick as honey or jam (Fig. 2 C-D).

Filtering: When the resin has a fluid consistency, it is strained through a piece of cloth to separate the foreign materials and is collected in a plate (Fig. 2 E).

Cooling, forming, packing and selling: The collected material is taken by hand before it gets cold and thick, and pressed with the help of the other palm to give a pattern. This patterned piece is left in cold water to thicken and take a shape (Fig. 2 F). Resin may be packaged in a variety of forms. The pine resin with different patterns is sold by women in the local markets (Fig. 3).

Usage of pine resin by local people: The raw material received from the pine trunk is mashed into powder, mixed with honey and used extensively to cure stomach and intestinal wounds.

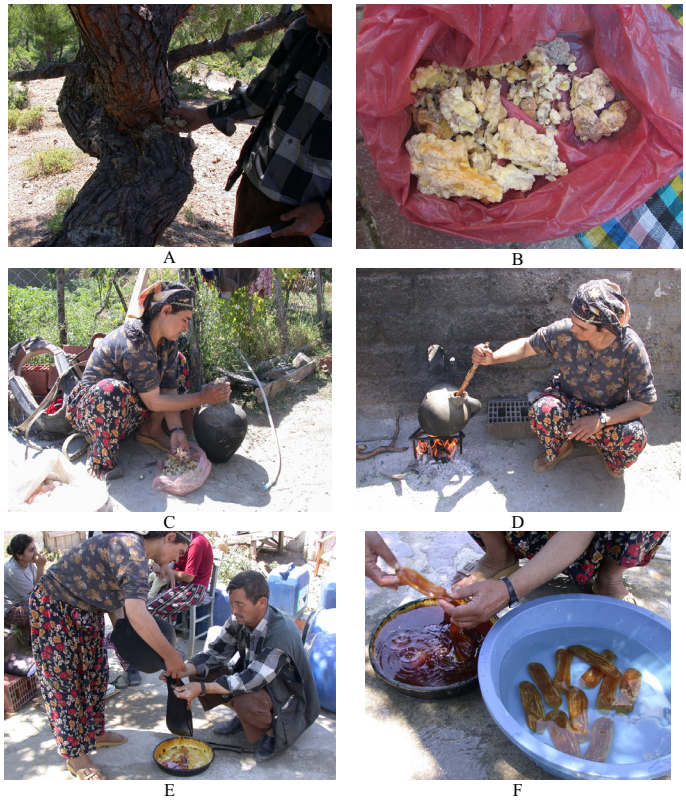

Figure 2. A-B: Pine resin collected from *P. brutia*; C: A local woman in casual daily dress putting pine resin into a pitcher; D-F: Pine resin production in Havran (D: Boiling resin in a pitcher on a fireplace, E: Boiled resin is filtered by means of a cloth, F: Pine resin ready for storage and subsequent consumption) (Photo: F. Satil).

Figure 3. The pine resin with different patterns is sold by women in the local markets (Photo S.Selvi).

Local people use it for mouth and teeth cleanse by chewing it as well as to get rid of mouth smell. People of Kazdağ use resin of *Pinus brutia* to relieve the symptoms of a cough. Pine resin is also used for medicinal aid in anti-diabetics, appetizing, healing digestive tract ulcers and injuries. Moreover, resin is applied to boils, heel cracks in the region. In addition, purposed to cure wound and cuts participate in ointment prepared by the local people (Table 1). Also, literature survey showed that resin obtained from *P. brutia* is used as antitussive, haemorrhoids, asthma, tonic and irritant in Turkish folk medicine [9-12], and it is chewed as gum, too.

Table 1. Usage of pine resin by local people in Kazdağ (Mt. Ida).

Local names	Preparation	Usage	Ailments treated, therapeutic effect	Administration, dosage, duration of the treatment
	Resin	Food		Chewing as gum
	Resin	Medicinal	Prevent bad breath Clean tooth	Chewing as gum
Çam, Kızılçam, Sakız çamı, Sorkuç, Akma, Çam akması	Resin + honey	Medicinal	Stomach ache Ulcer Anti diabetics Appetizing	O. ad. eaten before breakfast every day for a week
	Resin + hot water	Medicinal	Wounds Cuts	Ext. applied
	Resin + hot water	Veterinary medicine	Wounds Cuts	Ext. (for animal)

O.ad.: Oral administration.
Ext.: External use.

The chemical characteristics and antimicrobial activities of pine resin: Crude resin obtained by tapping living pine trees is a thick, sticky, but usually, still fluid material. *Pinus* sp. produces gum oleoresin, which is used as a raw material for rosin and turpentine. Through distillation process, gum oleoresin is converted into rosin and turpentine [3, 13-15].

Rosin is a complex mixture that contains, mainly, rain acids and a little amount of neutral fraction. It is the major product obtained from pine and is in volatile residue. It is a brittle, transparent, glassy solid insoluble in water, but soluble in a number of organic solvents. It contains mostly diterpene acids, monoterpenes and is used in a wide range of products extending from the chemical to the medical and cosmetic industries. It is also used in adhesive compositions, in antifouling paints, in coatings and in dry toners[9, 16, 17]. The chemical composition of colophony, obtained from different localities, is shown in Table 2 [18].

Turpentine is characterized by both its starting material and production process. All turpentines are produced from *Pinus* spp. trees. Turpentine oil is derived from the oleoresin (balsam) collected from the tree. Distillation of this material produces

Table 2. Contents of constituents of rosin (*Pinus brutia*)[18].

	AP	CH	SC
1. α-Pinene	18.4 - 22.9	18.8 - 48.4	16.8 - 25.5
2. Camphene	0.6	0.5 - 0.8	0.4 - 1.0
3. β-Myrcene	-	0.3	0.5
4. β-Pinene	2.7 - 8.8	6.0 - 12.6	2.3 - 4.0
5. Sabinene	-	-	-
6. Δ3-Carene	1.9 - 4.7	7.7 - 14.0	3.0 - 9.1
7. *p*-cymene	-	-	-
8. Limonene	1.3 - 10.5	0.2 - 1.9	1.3 - 12.6
9. Bornylene	-	-	-
10. 2-Propenoic acid,2-methyl-2- hydroxypropyl ester	11.2	2.5	12.8
11. 2-Propenoic acid,2-methyl-3-hydroxypropyl ester	5.1	0.6	0.9
12. γ-Terpinene	0.6	0.4	0.5
13. α-Terpinolene	-	-	1.3
14. Linalool	1.9	0.5	0.8 - 2.6
15. Terpinene-4-ol	0.8 - 1.8	0.8	0.6 - 1.4
16. Terpineol	-	-	0.5
17. *β*-Fenchol	-	1.4	-
18. Borneol1	-	-	-
19. Linalyl propionate	-	-	2.8 - 3.8
20. Linalyl acetate	2.1 - 7.6	1.5 - 2.2	3.9 - 10.3
21. Longifolene	-	-	-
22. Linalyl butyrate	-	-	-
23. Isocaryophyllene	-	-	-
24. *trans*-caryophyllene	0.6 - 2.3	0.6 - 3.9	0.8 - 2.0
25. Geranyl propanoate	0.1	0.2	-
26. Caryophyllene oxide	-	-	-
27. Humulene oxide	0.3 - 1.9	0.3 - 1.7	0.4 - 1.8
28. Junipene	1.0 - 2.4	0.7 - 3.3	1.0 - 1.7
29. Palustric acida	9.4 - 19.5	9.4 - 21.6	11.0 - 17.8
30. Kaura-9(11),16-dien-18-oic acida	4.7 - 15.6	9.1	3.1 - 9.5
31. Dehydroabietic acida	-	-	3.8
32. Neoabietic acida	1.3 - 1.5	4.3 - 11.3	1.4 - 9.9
33. Abietic acida	8.7 - 24.5	6.9 - 20.4	7.6 - 23.3
Total diterpenic acid	27.6 - 64.9	21.9 - 62.4	23.1 - 52.3

AP: Acid paste.
CH: Carved hole.
SC: Scraping.

Table 3. Main contents of turpentine (*Pinus brutia)*[19].

	THA main components of natural turpentine (*Pinus brutia*)		*P. brutia* needle oil	
	Components	% Percentages of components	Components	% Percentages of components
1.	α-Pinene (C10H16)	50	α-Pinene (C10H16)	17.62
2.	Camphene (C10H16)	1.6	β-Pinene (C10H16)	57.93
3.	β-Pinene (C10H16)	29	Δ-3-Carene (C10H16)	0.15
4.	Δ-3-carene (C10H16)	14	Limonene (C10H16)	0.15
5.	Limonene (C10H16)	0.6	Linalool (C10H18O	1.83
6.	β-Phellanrene (C10H16)	0.05	Linalyl acetate (C12H20O2)	3.02
7.	p-Cymene (C10H14)	0.2	β-Caryophyllene (C15H24)	0.5
8.	α-Pinene oxide (C10H16O)	1.1	Myrtenal (C10H14O)	1.0
9.	(+)-Longifolene (C15H24)	0.33	Pinocarveol (C10H16O)	1.62
10.	Myrtenal (C10H14O)	0.01	α-Terpineol (C10H18O)	1.90
11.	Myrtenol (C10H16O)	0.6	Amorphene (C15H24)	0.4
12.	Caryophillene oxide (C15H24O)	0.5	Myrtenol (C10H16O)	0.53
13.	Other	2.01	Caryophyllene oxide (C15H24O)	8.33
14.			Other	5.02

turpentine oil and the solid rosin [14]. Turpentine is a clear liquid with a pungent odour and bitter taste. It is composed of a number of organic compounds, primarily a series of volatile fractions known as terpenes. Turpentine is used as solvent, synthetic borneol, synthetic camphor, synthetic resin, synthetic terpinol, elastomeric composites, pesticide, military use, shoe polish and related materials, rubber, printing inks, adhesives and plastics, asphaltic products, furniture, insecticide and disinfectants [8].The chemical composition of turpentine is shown in Table 3 [19].

The antimicrobial activities of several parts of *P. brutia* were investigated [20, 21]. Chloroform, acetone and methanol extracts of leaves, resins, barks, cones and fruits of *P. brutia* were prepared and tested against some microbial groups. The extracts of the parts of the tree had no antifungal effect. The chloroform extract of the bark inhibited the growth of *E. coli*, with an inhibition zone of 8 mm. All the extracts tested inhibited the growth of all the other bacteria tested with zones of inhibition between 9-19 mm. *B. subtilis* growth was inhibitd by the acetone extract of the bark [20].

Conclusions

The pine resin, known as non-wood forest product, is of significant importance for sustainable forest management in the region. The production of resin (and from it turpentine and rosin) by tapping brings with it many social and economic benefits. It provides employment and income opportunities for people in rural areas, including women.

A research carried out in the region shows that pine resin was produced traditionally at mass till 10 to 15 years before. Nowadays, production by traditional methods is done only by a very few people. There seems to be two basic reasons for the decrease: the pine gum has lost its economical value and the *P. brutia* forests in the area are removed for the favour of housing projects. There are still some people selling pine resin in the traditional markets.

Literature reviews and field observation reports suggest the following points to maximizing the profit in resin tapping work in case of Turkey:

1. Back shaving and cutting manually takes much time; so, mechanization of work should be helped to save time and money.
2. Metal pots (tin) are leakage. They contaminated with the resin and degrade the quality; so, it should be better use polythene pots.
3. Possibilities of forest fire should be minimized.
4. New techniques like bore-hole method should be practiced in the region.

It is known that, generally in the production of non-wood forest products, traditional and primitive methods have been used and there is uncertainly in the non-wood forest products market in Turkey. On the other hand, in order to apply new and modern techniques, employees and other persons relating the processes should be educated.

In the resin production without deteriorating the ecosystem, the most suitable tapping, transportation and stockpiling activities should be used. Especially, education of the employees, carefully selection of the tolls used for the production of the resin and some substructure services as a construction and maintenance of the forest road network will affect productivity and quality.

The natural growing fields of *P. brutia* are opened to build constructions. Threats to *P. brutia* in Turkey include destructive harvesting techniques and habitat loss. It has been observed that, there is not a serious threat factors for *P. brutia* populations in near future. However, particularly in last decade, pine resin is intensively collected for trade. Therefore, regeneration of the population is negatively affected and the generations of the plants may be under risk in long period. Prohibitions or restrictions on their collection are needed.

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