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Pinaceae Species: Spruce, Pine and Fir as a New Culinary Herb and Spice

Nabila Rodríguez Valerón, Diego Prado Vásquez
and Rasmus Munk

Abstract

The Pinaceae family has traditionally been used as medicine, resorted to as a famine food and for ornamental purposes as Christmas trees. In the last few years numerous restaurants have been using different species of *Pinaceae* family as a garnish or an aromatic spice, using them in different culinary applications like oils and infusions to flavor dressings and broths. *Abies grandis* (Grand fir), *Pseudotsuga menziesii* (Douglas fir), *Pinus sylvestris* (Scots pine) and *Picea abies* (Norway spruce) were researched on taxonomy, habitats and non-edible uses, culinary traditions, health and nutritional properties, aroma profile. The main compounds in Pinaceae family are monoterpenes, oxygenated monoterpenes, sesquiterpenes, oxygenate sesquiterpenes, diterpenes and hydrocarbons, especially α - β -pinene, limonene, α -terpinene, and even bornyl acetate, responsible for aroma compounds such as citrusy-, woody-, herbal-, or piney aromas. Modern gastronomy uses, sensory analysis and culinary applications were applied for demonstrating the possibilities on modern culinary application in this novel yet traditional spice.

Keywords: Spruce, Fir, Pine, Pinaceae, Spice, Herbs, Culinary

1. Introduction

The Pinaceae family species has been used for many years as an edible food source, especially the genera *Abies*, *Pseudotsuga*, *Pinus* and *Picea*. Among *Abies grandis* (Grand fir), *Pseudotsuga menziesii* (Douglas fir), *Pinus sylvestris* (Scots pine) and *Picea abies* (Norway spruce) are the most common in contemporary and traditional gastronomy [1] (**Figures 1-4**).

1.1 Taxonomy, habitats and non-edible uses

All the species mentioned above have a long history of supplying pitch, turpentine, wood, tar and resin for construction, but also as medicine (**Table 1**). People used to chew the hard amber colored resin of pine as toothpaste. It was rubbed on the teeth to whiten them, and in spring the fresh resin could be applied to wounds to encourage healing [7].

Abies grandis (Grand fir) is most common in lowland coastal areas. It grows from near the sea level to ca. 1,800 m a.s.l., on a variety of soils derived from granitic



Figure 1.
Abies grandis (Grand fir) [2].



Figure 2.
Pseudotsuga menziesii (Douglas fir) [3].

or basaltic rock. It grows best on alluvial soils with a relatively high ground water table. Rapid growth and great size make this species an important tree for producing timber. The wood is soft and white and an excellent source of pulpwood. Young trees are valued as Christmas trees because they tend to grow very symmetrically and have glossy green foliage. Grand fir is a common sight in large gardens and city parks and it was planted in nearly all landscape gardens laid out in the nineteenth century in Europe [8].

Pseudotsuga menziesii (Douglas fir) is common in a variety of climatic zones, landscapes and habitats. It benefits from high rainfall, yet also grows well on better drained sites, commonly on slopes or elevated, no longer flooded river terraces. Giant trees can measure up to 100 metres, Somewhat further inland the species also grows



Figure 3.
Pinus sylvestris (Scots pine) [4].



Figure 4.
Picea abies (Norway spruce) [5].

in valley bottoms near streams, still reaching great height and living up to 800–1,000 years. These coniferous forests are of similar composition as those on the coast. Var. *glauca* is a smaller, but still quite large tree that grows in the Rocky Mountains [9].

Douglas fir is one of the world's most important timber trees. The huge size, especially of the coastal variety, as well as the excellent wood properties make it the preferred tree for knot-free sawn timber of great length. However, the more continental variety *P. menziesii* var. *glauca* grows much slower and to a more moderate size, thus yielding denser, heavier wood, excellent for cooperage for vats and tanks for breweries and distilleries. Douglas fir has been introduced to many countries in

Specie	<i>Abies grandis</i> (Douglas ex D.Don) Lindl.	<i>Pseudotsuga menziesii</i> (Mirb.) Franco	<i>Pinus sylvestris</i> L.	<i>Picea abies</i> (L.) H. Karst
Kingdom	<i>Plantae</i>	<i>Plantae</i>	<i>Plantae</i>	<i>Plantae</i>
Phylum	<i>Tracheophyta</i>	<i>Tracheophyta</i>	<i>Tracheophyta</i>	<i>Tracheophyta</i>
Class	<i>Pinopsida</i>	<i>Pinopsida</i>	<i>Pinopsida</i>	<i>Pinopsida</i>
Order	<i>Pinales</i>	<i>Pinales</i>	<i>Pinales</i>	<i>Pinales</i>
Family	<i>Pinaceae</i>	<i>Pinaceae</i>	<i>Pinaceae</i>	<i>Pinaceae</i>
Genus	<i>Abies</i>	<i>Pseudotsuga</i>	<i>Pinus</i>	<i>Picea</i>

Table 1.
Taxonomy of the most widely used species [6].

plantation forestry as well as an ornamental tree and a good number of cultivars are known and used in horticulture. In the NW USA and W Canada it is also grown as a Christmas tree [9].

Pinus sylvestris (Scots pine) grows naturally in a variety of habitats, the common denominator of which is deficiency of nutrients in the soil. Thus, on the Atlantic seaboard with high levels of precipitation it grows on ancient igneous or metamorphic rocks with little or no soil – in Scotland and Norway up to 70o N, while south of the Baltic Sea it grows on podzolized glacial sands left after the Ice Age. In the central Alps it is restricted to the drier slopes and valleys below other conifers like *Picea*, while in the Caucasus it ascends to 2,600 m on rocky outcrops and scree. In much of Siberia, it occupies the drier sites, but in Scandinavia and NE Europe it often borders acidic peat bogs. In the steppes of Russia and Mongolia it only grows along stream courses [10].

Pinus sylvestris is an important timber tree, but most of the production goes to the paper industry. Most of the ‘pine’ used for furniture in W Europe is in fact spruce (*Picea abies*). In Russia and Scandinavia resin is extracted by “destructive distillation” from the stumps and roots of felled trees to produce “Stockholm tar” which is used as a wood preservative. In much of western Europe, it is a widely planted forestry tree for timber; it was introduced in the USA for similar purposes and for use as Christmas trees [10].

Picea abies (Norway spruce) is widespread and dominant in Boreal conifer forests of northern and northeastern Europe, the natural distribution shows continental tendencies but in the western mountains of Central Europe an ecotype has evolved that is adapted to sub-Atlantic weather conditions with heavy ‘wet’ snowfall in early winter. Although it can grow on most substrates, it is most common on acid soils [6].

Norway spruce is an important timber tree in Europe. Outside the Boreal Forest zone most commercial timber is now harvested from plantations or from managed forests in which other trees are suppressed. The wood is used for pulpwood as well as construction, furniture (most of the popular ‘pine’ furniture is made with wood from Norway spruce), and for special purposes like the sound boards of pianos and the bodies of guitars and violins. The famous Stradivarius violins were made with wood of Norway Spruce from the Alps. In Europe this species is the most popular Christmas tree [6].

2. Culinary traditions

As for culinary uses, the *Pinaceae* family has mainly been used as a famine, emergency, or survival food in different traditional communities in Finland, Sweden and Norway, for example the indigenous Sámi people. It is also consumed in northwestern North America and Russia for the same purposes [7].

Considered as a famine or emergency/survival type of food, the inner bark (cambium) of *Abies grandis* (Grand fir), *Picea abies* (Norway spruce) and *Pinus sylvestris* (Scots pine) has been eaten cooked, usually dried, and then ground into a powder. It is then used as a thickening in soups or mixed with cereals to make bread [11]. Large sheets of bark of *Pinus sylvestris* are taken from trees in spring and early summer by the Sami people in northern Sweden and Finland and either dried and ground into a flour (as *Abies grandies*) or eaten directly (fresh) “as delicacies”. The flour can be stored for a long period of time and can be mixed with reindeer milk, fat from boiled milk, blood or fish and meat soups. Pine inner bark has probably also been used as a seasoning, added to meats instead of salt. It has also been used to make flat bread chips where the main ingredient was Scots pine inner bark, it is seasoned with brown sugar and roasted over fire [7].

Young pine cones from different *Pinus* spp., like *Pinus kochiana* and *Pinus sylvestris*, have been used in Armenia, Eastern Europe, Russia and Georgia to make jam, syrup and confiture. Immature female cones from *Picea abies* have also been used this way [12]. *Abies* spp. have also been used for making chewing gum from needles, branches and cones [13]. *Picea abies* and *Abies grandis* resin has been consumed as chewing gum in Sweden and North [11, 14], also sap of several *Pinus* spp. has been used for drinks and reduced to make syrups [13].

There are approximately 29 *Pinus* spp. that produce seeds that have been used as food items [15]. The most valuable one is *Pinus pinea*, that is traditionally used to produce pine nuts in Mediterranean countries like Italy, Turkey, Spain and Portugal [16]. In Turkey it is commonly eaten as a snack or for making sweets like “halva” and cold drinks [17]. Native North Americans used to make them into a butter or grinded them to make balls as delicacies [14].

Young twigs and leaves from *Pseudotsuga* spp. and *Abies* spp. have been used as a substitute for coffee, spruce beer from *Picea* spp. has been made from the shoots and an infusion of the leaves has been used as a beverage [13] young shoot tips are also used as a tea substitute [14, 18]. *Picea abies* and *Pinus sylvestris* shoots and catkins have been eaten raw or cooked as snacks and added to other recipes as a flavoring (Table 2) [11, 12].

Specie	Parts used	Use	Source
<i>Abies grandis</i> (Douglas ex D.Don) Lindl.	Inner bark	Bread, stews	[11, 13, 14]
	Resin, gum	Candy, drink	
	Shoots	Infusion, drink, Snack	
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	Inner bark	Bread	[13, 14, 18]
	Resin	Snack, drink	
	Sap	Candy, drink,	
	Shoots	sweetener	
	Branches, leaves	Infusion, drink, candy	
<i>Pinus sylvestris</i> L.	Inner bark	Bread	[6, 11, 12]
	Seed	Nuts	
	Shoots	Snack, flavoring	
	Catkins	Snack, flavoring	
	Pinecones	Jam, candy	
<i>Picea abies</i> (L.) H. Karst	Inner bark	Bread	[12, 13]
	Shoots	Snack, flavoring, drink	
	Catkins	Snack, flavoring	
	Pinecones	Jam, candy	

Table 2.
Traditional common uses of Pinaceae spp.

3. Health and nutritional properties

In the past few years nutraceutical products that claim to counteract human diseases have received increasing attention. The products are enriched with natural extracts such as ginger, onion, garlic, turmeric, etc.

The use of pine (*Pinus sylvestris*) was an important nutritional factor that historically helped prevent scurvy (from Vitamin C deficiency). The high nutritional value of inner bark when peeled in spring is well known today. Important nutrients from inner bark include carbohydrates, vitamin C, and fiber to balance the consumption of protein and fatty meat, fish and reindeer milk from which the bulk of calories, protein, minerals and vitamins were derived [19] (**Table 3**).

Pinaceae species have been investigated by scientific communities because of their potential properties in food, medicine, and cosmetics. *Picea abies* has recently been studied for its potential antimicrobial activity in which the main bioactive compounds are aldehydes, ketones, alcohols, esters, and hydrocarbons [21].

One study proved the antibacterial activity of *Picea abies* extract on the growth of *E. coli* interfering with the metabolic activity of the microorganism [21]. Furthermore, other studies have identified that compounds responsible for antimicrobial activity are present in the *Picea abies* species. Specifically, monoterpenes such as α -terpineol, α -3-carene, α and β -pinene, limonene, γ and β -terpinene, linalool, borneol as well as sesquiterpenes such as cadinene, γ -muurolene, α -humulene, all of them are responsible for its aroma profile [21].

Essential oil from various *Pinaceae spp.* trees is often associated with a positive impact on health. It has been noted to have relaxing effects when inhaled or and to counteract certain mental health issues, for instance sleep disorders. Other results reported are that some molecules making up the aromas, such as α -pinene, can relieve stress [22]. In addition, the atmosphere in forests impacts the cerebral activity. Based on all these observations compounds present in *Pinaceae spp.* can be related to relaxation of the human body [23].

Pine nuts are well-known around the world because of their nutritional value, and widely eaten in Turkey and Spain among other countries. They are high in vitamin E and K, minerals such as iron, magnesium, phosphorus, zinc, copper, potassium, and manganese. Moreover, they are a source of fiber, niacin, and riboflavin, and high in polyunsaturated fats [24].

Pseudotsuga menziesii cones among other species of *Pinaceae spp.* have been studied for their antioxidant activity. In one study on the possible bioactive effects in humans, the samples gave a positive result for anti-viral and anti-bacterial properties [25]. This study analyzed the total phenol content (TPC), the ferric reducing

Part used	Energy (kcal)	Water	Protein	Fat	Carbohydrates	Starch	Total Sugars	Ash
Inner bark (Summer)	107,6	62,2	0,8	2,0	9,9	6,7	3,2	0,64
Inner bark (Autumn)		62,4	2,33		4,3	0,65	3,3	
Inner bark Flour (Summer)			1,5	2,3	6,0			

Table 3.
Comparisons between nutritional content of Scots Pine (*Pinus sylvestris* L.) inner bark harvested in summer and autumn [7, 20].

ability of plasma (FRAP), and 2,2-diphenyl-1-picrylhydrazyl, in three different stages of cones, green, matured and opened, resulting in high scores in the first, green, stage for all the species [25].

The terpenes such as pinene, limonene (both enantiomers), 1,8-cineole, and borneol were studied as anti-bacterial agents to counteract *Listeria monocytogenes*. Pinene was the most active component and 1,8 cineole and borneol less, therefore they might be considered to *Listeria* or to prevent its growth. These kinds of molecules are present in fir, pine, and spruces, and they are considerably cheaper than essential oils from spices and herbs, because most of the antimicrobial activity comes from phenolic compounds [26].

4. Aroma profile

Pinaceae spp. represents the largest genus of the conifers, with many different species spread over the world, especially in North America, Europe and Asia. There are also a few in south-east Asia and even some in South America. It is the most common tree in the world and a popular material for the manufacture of wood products, and due to its characteristic smell it is commonly used as a natural and pleasant aroma [26].

Furthermore, the species produces oleoresin, the mix of monoterpene (C10), sesquiterpene (C15) and diterpenes (C20) commonly called resin acids and phenolic compounds. Conifers use them as a form of chemical defense in needles and wood to deter insect attacks and to inhibit the growth of fungi [22, 27].

The organoleptic profile of *Pseudotsuga menziesii* is mainly created by monoterpenes such as (Z) and (E)- β -ocimene (green, woody, tropical), β -pinene (piney, woody, terpy), sabinene, α -terpinolene (woody, terpy, citrus), α -terpineol (woody, earthy, cooling), γ -terpinene (citrus, terpenic), limonene (citrus, herbal, terpenic) or geranyl acetate (fruity, floral, rose) and citronellyl acetate. On the other hand, *Picea abies* contains different concentrations of monoterpenes, oxygenated monoterpenes, sesquiterpenes, oxygenate sesquiterpenes, diterpenes and hydrocarbons. Volatile compounds such as α - β -pinene, limonene, ρ -cymene (woody, terpy, harsh), (E)-caryophyllene (woody, camphoric, peppery), δ -cadinene (woody), bornyl acetate (camphor, woody, pine), β -phellandrene (green and terpy) or δ -3-carene (citrus) are responsible for the characteristic aromas of this species of pines [28].

Abies grandis contains a complex mixture of monoterpenes, sesquiterpenes and diterpenoid acids, used to deter insect pests and their symbiotic fungal pathogens [29]. In previous research, it was shown that the leaf oil of *Abies grandis* is dominated by β -pinene (20.3–31%), responsible for piney, woody flavor; bornyl acetate (12.7–26.2%), for balsamic odor and camphoreous flavor; β -phellandrene (13.7–25.2%), responsible for minty odor; and camphene (8.3–11.5%), giving a woody, fir needle odor and camphereous, minty, green, spicy flavor, with moderate amounts of α -pinene (4.4–7.4%), responsible for herbal, pine, fresh odor and woody, tropical flavors; α -terpinene (1.1–2.2%), responsible for woody, citrus odor and terpenic, citrus, lemon and lime flavor; terpinolene (1.3–2.9%), giving a herbal, pine, citrus odor and woody, lemon, lime and floral flavor; and α -terpineol (1.1–3.6%), responsible for terpenic, pine, citrus and floral odor, lemon, lime and woody flavors [21, 28].

According to a study performed by the department of botany and genetics at Vilnius University in Lithuania, the composition in needle essential oil for *Pinus*

Pinus sylvestris L. is principally formed by α -pinene [30] that contributes aromas to pine, cypress, citrus fruits, herbs, spices, and mastic [28]. *Pinus sylvestris* L. is mainly composed of α -pinene (22.48%) which aromas are piney, woody [28]; σ -3-carene responsible for citrus and terpenic aroma [31]; muurolol (4.42%) responsible for herbal and honey [32]; camphene (3.39%) or germacrene (2.97%), giving woody aroma, and minty-cooling flavor [28]; β -caryophyllene (3.32%) responsible for spicy-peppery- notes [32]; β -elemene (1.79%) responsible for herbal aroma, myrene (1.57%), β -pinene (1.52%), bornyl acetate (1.79%) and β -ocimene (1.12%) all of them are responsible for woody, green, citrus, or camphor aroma. In lower concentration are β -phellandrene (0.86%) responsible for green, terpy; α -humulene (0.84%), γ -muurolene (0.82%), α -copaene (0.73%), or sabinene (0.45%) responsible for woody [28].

Also, other compounds are present in the aroma profile of this species, such as (E)-2-hexenal (0.32%) responsible of fruity aroma; terpinolene (0.30%) giving citrus (lime peel) and woody aroma; 2-undecanone (0.27%) and undecanone (0.05%) giving fruity aroma; terpinolene (0.30%) responsible for citrus; α -terpineol or terpinyl acetate (0.08%) giving floral notes such as lavender or citrus notes such as lime [28, 30].

A study performed by Friedrich-Alexander-Universität Erlangen-Nürnberg detected the presence of 44 odor-active compounds in wood from *Pinus sylvestris* L. Among the main compounds identified were fatty acid degradation products, and some terpenoic substances [22]. The majority of the molecules identified were (E,E)-nona-2,4-dienal, vanillin, phenylacetic acid, 3-phenylpropanoic acid, δ -octalactone and α -pinene. Also 11 compounds were identified for the first time as odor substances in wood, among them the heptanoic acid, γ -octalactone, δ -nonalactone and (E,Z,Z)-trideca-2,4,7-trienal [22].

According to the results of the study in wood, the presence of α -Pinene is high, which is to be expected since it is long known to be an aroma component in *Pinus sylvestris*. The fatty notes come from mono- and di-alkenals, such as (E,E)-Nona-2,4-dienal and (E,E)-Deca-2,4-dienal – for the first time reported in wood. The cheesy aroma can be assumed to result from pentanoic acid, butanoic acid as well as 3-methylbutanoic acid. The phenylacetic acid can be related to the honey-like notes, and vanillin to the vanilla-like aroma. Furthermore, the citrusy notes can come from octanal, linalool or nonanal whereas green and grassy aromas from pentanal and hexanal compounds. The pencil-like smell can be assumed to result from

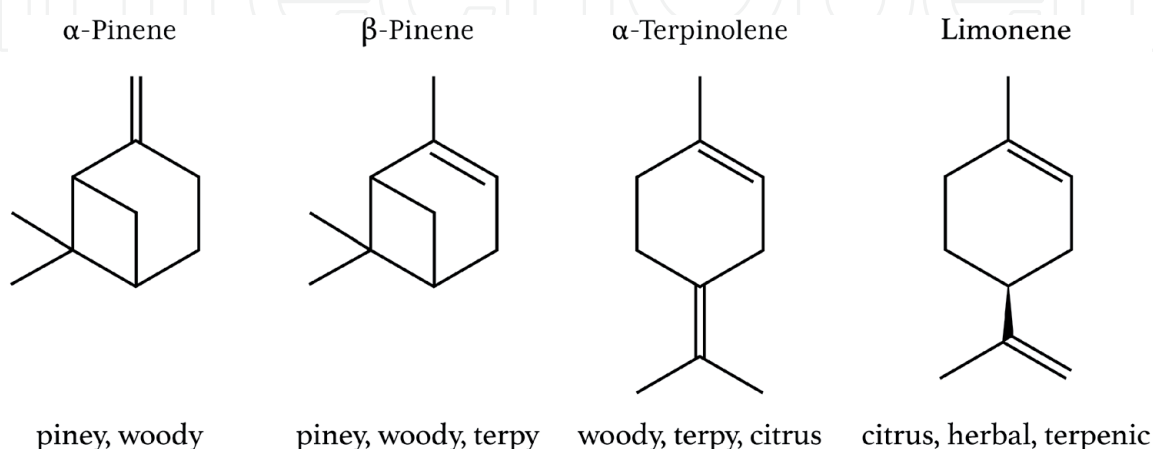


Figure 5.
Principal aroma components in *Pinaceae* spp. [33, 34].

thymoquinone, whereas peppery and plastic like aromas from α -bisabolol. There have also been found vomit-like notes that can be associated with 3-phenylpropionic acid or blood-like and metallic aromas can be trace back to (E,Z,Z)-trideca-2,4,7-trienal molecules [22]; – these are of course less pleasant in gastronomic applications (Figure 5).

5. Modern gastronomy uses

In more recent research modern contemporary restaurants have been using to use several *Pinaceas spp.* often in combination with new culinary techniques.

Shoots from *Pseudotsuga menziesii* (Douglas fir), *Abies grandis* (Grand fir) and *Picea abies* (Norway spruce) are used in contemporary cuisine. They are served raw or cooked as garnish in different preparations like fish, meats and salads [35, 36]. Shoots and leaves are used as a spice in creams and chocolate ganache [37]. Branches and shoots are being used to make “gin” and sodas [38, 39]. Also, flavored salt is use blending salt and leaves [40].

Oils and flavored butters can be made from different *Pinaceas spp.* with different techniques like blending or infusing with neutral oils. *Pinus spp.* shoots can be used to infuse oil (neutral sunflower oil) to make “pine shoot oil” as seasoning for a fish dish [41]. Green pines cones can be cold infused to make green pine cone oil as a seasoning [42]. Or mixed leaves with butter infused in a vacuum bag and cooked at 80°C for 10 hours [43].

Other techniques are used for the leaves, like blending and sous vide-cooking to improve the flavor, and extracts mixed with flour has been used to make udon noodles [44]. Emulsions like mayonnaise can be made with the blended and strained oil [35, 45]. Pickles and vinegar from young shoots of *Abies grandies*, *Pseudotsuga menziesii* and *Picea abies* can be made by adding vinegar [40].

Green pine cones have been used as a flavoring for infusions to make granités, dehydrated merengues and gelatins [46], also for making jams and syrups. The leaves can be blended with simple syrup [47].

Wild yeast from *Pinus spp.* has been used to make fermented drinks, both alcoholic beverages and low alcoholic “sodas”, using leaves, cones and branches [48].

Specie	Parts used	Technique/use	Source
<i>Abies grandis</i> (Douglas ex D.Don) Lindl.	Shoots	Spice, herb, pickle, beverage	[45]
	Leaves	Spice, beverage, oil, syrup	
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	Shoots	Spice, herb, pickle, beverage	[35, 36]
	Leaves	Spice, beverage, oil, syrup	
<i>Pinus sylvestris</i> L.	Leaves	Spice, beverage, oil, syrup	[42, 46]
	Flowers	Pickle, herb	
	Cones	Jam, syrup, pickle	
<i>Picea abies</i> (L.) H. Karst	Shoots	Spice, herb, pickle, beverage	[35]
	Leaves	Spice, beverage, oil, syrup	

Table 4.
Modern contemporary uses of *Pinaceas spp.*

Pinus spp. species pollen has been used as thickening agent, and mixed with flour to make bread and pastries [48] (**Table 4**).

6. Sensory analysis

A study carried out by restaurant Alchemist in Copenhagen, Denmark, showed that three different species of *Pinaceae*, *Abies grandis*, *Picea abies* and *Pseudotsuga menziesii* have completely different aroma profiles [1].

In the sensory analysis study *Abies grandis* was related to different attributes, such as citric, present in young needles for this specie, as it is shown in **Table 5**. Other attributes such as intense flavor, grapefruit flavor or “not woody” were found. These attributes might be related to the concentration of different terpenes such as limonene, β -pinene, sabinene or camphene. Despite that the concentration of bornyl acetate is a compound highly related to woody attribute, “not woody” was the most selected attribute [1].

According to the same study *Pseudotsuga menziesii* was related to natural, dark color, not astringent and bitterness [1]. These attributes might be related to the terpenes concentration such as α -pinene, phellandrene, or sabinene [49].

Abies grandis is related to *Pseudotsuga menziesii* citric attribute is common in both samples but is perceived with more intensity in *Abies grandis* [50].

On the other hand, the *Picea abies* attributes are in complete contrast to the other species (**Table 5**). This result is what was expected, since the aroma profile is different, as demonstrated in a research conducted by Nabil Haman at Piazza University [21].

Astringent is one of the molecules in major concentration (typical in this species), and directly related with astringency in this samples. Besides, the concentration of cinnamon acid (responsible for cinnamon aroma) or ferulic acid (responsible for vanilla aroma) [51] might be closely related to sweetness.

<i>Abies grandis</i>	<i>Pseudotsuga menziesii</i>	<i>Picea abies</i>
Citrusy	Natural	Astringent
Grapefruit flavor	Dark color	Sweet
Intense flavor	Not astringent	Earthy
Not woody	Bitterness	Woody
Fruity flavor	Citrusy	Crunchy

Table 5.
Summary of the most characteristic attributes used to describe each sample.

<i>Pinaceae</i>	Ice cream	Mean	Spruce tonic	Mean
<i>Picea abies</i>	109	4.687	230	4.855
<i>Pseudotsuga menziesii</i>	612	4.072	851	4.506
<i>Abies grandis</i>	534	4.759	467	5.048
	p- value	0.366		0.102

Table 6.
Averages liking of scale 1–9 in ice cream and gin tonic per each sample of spruces and p-value.

Furthermore, in the same study two different culinary applications were performed, according to the attributes for each species. One of the applications was an ice cream, according to Angelo Corvitto's recipe [52] with some modifications according to another research [1]. The second application was an alcoholic cocktail, spruce tonic, prepared according to Difford's guide [53] with Pinaceae spirit (40%) and tonic water [1].

Table 6 shows the averages for liking for each sample. *Abies grandis* has the highest score for both recipes, 5.048 for the spruce tonic, followed by *Picea abies* and *Pseudotsuga menziesii*. For the ice cream the average liking is 4.759 for *Abies grandis* followed by *Picea abies* and *Pseudotsuga menziesii* as is shown in **Table 6**. The reason that *Pseudotsuga menziesii* was less accepted by consumers might be related by bitterness. Also, the consumers acceptability of *Abies grandis* for both recipes might be related to citric flavor [49].

6.1 Culinary applications

According to the results from the sensory analysis of the *Pinaceae spp.* Article [1] two recipes were developed in the Alchemist restaurant development kitchen.

6.1.1 *Abies grandis* ice cream and spruce complements

Abies grandis ice cream, blueberry jam, pickled *Pinus spp.* shoots and *pinus sylvestris* inner bark crumble (**Figure 6**).

6.1.2 Spruce tonic

Douglas fir spirit was used to make a version of a gin tonic, replacing the gin with the Douglas fir spirit and drops of Douglas fir syrup (**Figure 7**).



Figure 6.
Dessert: *Abies grandis* ice cream and spruce garnishes.



Figure 7.
Cocktail: Spruce tonic.

7. Conclusions

In the past, *Pinaceae* spp. has been considered as emergency or survival food during years of famine, and even as something shameful to eat [7]. But in the last years the consumption of *Pinaceae* spp. as a herb and spice has increased thanks to fine dining restaurants like elBulli in Spain or Noma in Denmark. Here the leaves, shoots, branches, pine cones and female flowers are used as a regular ingredient showcasing the potential of this species as a herb and spice [36, 42].

Until now, *Pinaceae* spp. has been considered as one flavor or generic aroma profile called “pine” or “spruce”, without taking into consideration the large differences between each species [1].

Pinaceae spp. has the same potential as many commonly used spices like cinnamon or vanilla, in many different levels of gastronomy from fine dining to home cooking. It can be added to almost any type of preparation as shown in the “Modern gastronomy uses” chapter.

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Author details

Nabila Rodríguez Valerón, Diego Prado Vásquez* and Rasmus Munk
Alchemist Explore, Research and Development, Alchemist Aps,
København, Denmark

*Address all correspondence to: dp@alchemist.dk

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