



Jasmine lactone: The chemical secret of an enchanting fragrance

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Abstract

Jasmine lactone is an organic compound naturally present in jasmine essential oil, as well as in other fragrant flowers such as tuberose and gardenia. It plays a key role in jasmine's characteristic aroma. Discovered in nature in 1930, its chemical structure was fully identified in 1962 through synthesis. Since then, it has been widely used for its olfactory qualities. Several methods can be used to extract this molecule, including supercritical carbon dioxide extraction, known for its precision and efficiency, and the more traditional steam distillation. Due to its delicate scent, jasmine lactone is highly prized in the perfume industry, used in the composition of numerous floral fragrances. It is also used in the food industry, particularly to flavor candies, desserts, and beverages. Its importance remains significant in sensory and industrial fields.

Keywords: Jasmine lactone; synthesis; perfume industry; food industry; Bibliometric analysis; Good Health and Well-being.

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1. Introduction

Natural products, or secondary metabolites, play a key role in the discovery and development of new bioactive substances (Atanasov *et al.*, 2021). Lactones are remarkable examples of secondary metabolites due to their biological activities and exceptional chemical structures. These compounds are produced by plants, bacteria, fungi, marine sponges, and other organisms (Krzyczkowska *et al.*, 2015; Sartori *et al.*, 2021; Kaur *et al.*, 2021). The IUPAC defines lactones as “cyclic esters of hydroxycarboxylic acids, containing a 1-oxacycloalkan-2-one structure, or analogues with unsaturation or heteroatoms replacing one or more carbon atoms in the ring.” The smallest compounds in this class, α -, β -, γ -, δ -, and ω -lactones, contain 3-, 4-, 5-, 6-, and 7-membered rings, respectively. γ - and δ -lactones are the most abundant in nature due to the high stability of their

lactone rings. It is estimated that there are more than 3,000 γ -lactones in nature. α -lactones can only be obtained by synthesis. Medium-sized lactones have 8 to 11 ring members, and macrolactones contain 12 or more ring members. Jasmin lactone is a naturally occurring molecule that is found in the essential oil of many flowers and is a member of the lactone family of cyclic esters (Ahmad et al., 1998). A strong aroma-active lactone, jasmine lactone is defined by its fruity, creamy, and flowery scent that evokes subtle notes of peach, apricot, and jasmine. As a δ -lactone, it is a member of a class of cyclic esters that, because of their strong odor impact at very low concentrations, greatly influence the smell profiles of foods, drinks, and fragrances. As a chemical family, lactones are well known in flavor and fragrance chemistry for their sensory value (Winter et al., 1962). They are found naturally in a variety of fruits, dairy products, and botanicals, and they play a crucial role in the development of detailed tastes in processed foods. Bibliometric data were sourced from the Scopus database, covering 26 years from 2000 to 2025. The analysis was conducted using Bibliometrix and VOSviewer. Top authors and countries implicated can be ranked and mapped to get more information (Donthu et al., 2021; Laita et al., 2024; Amiruddin et al., 2025; Merzouki et al., 2025; Mangubat and Saeedi, 2026).

Jasmine lactone has been recognized in the food and beverage sciences as a major volatile contributor to the attractive fruity-floral scent of tea (*Camellia sinensis*) and other products produced from plants. Along with methyl jasmonate and other lactones, jasmine lactone was identified as one of the main scent components in Ceylon tea in important analytical work from the 1970s utilizing gas chromatography–mass spectrometry (GC-MS) (Oualdi et al., 2025) (Yamanishi et al., 1973). The biosynthetic processes by which jasmine lactone is produced in tea leaves have been clarified by later research, which has connected its development to lipoxygenase activity and fatty acid oxidation under growth and processing conditions. (Zeng et al., 2018).

2. Origin and history

The classification of lactones in natural perfumes and more general discoveries in aroma chemistry is related to the historical understanding of jasmine lactone. Long before specific molecules like jasmine lactone were chemically identified, early perfumery research prioritized lactones as significant producers of fruity and flowery smells. Following its natural isolation from jasmine oil in the early 1960s and further stereochemical studies, jasmine lactone was shown to be a naturally occurring odorant with multiple enantiomeric forms, particularly in *Jasminum grandiflorum* and *Polianthes tuberosa* (Figure 1) (Blaser et al., 1991). Lactones were eventually categorized in perfumery literature as a unique olfactory family with identifiable sensory functions, especially after research was done on their natural occurrence and odor features (Demole et al., 1962).

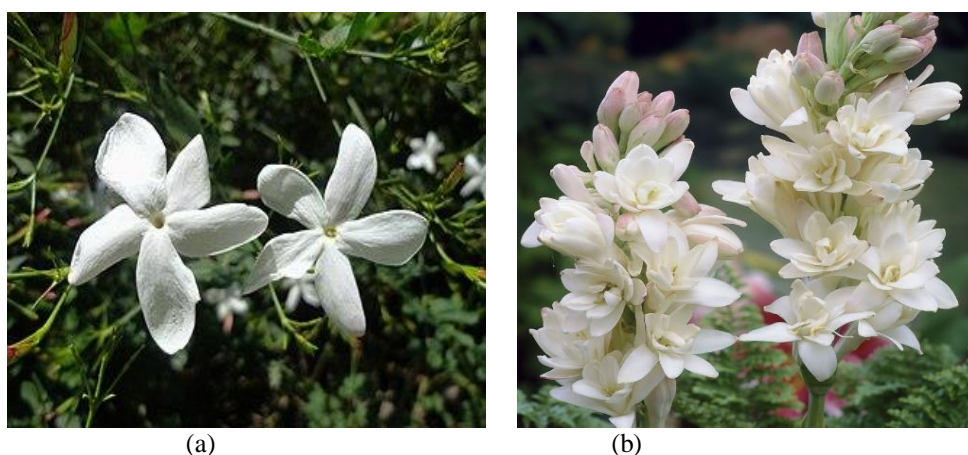


Figure 1: (a) *Jasminum grandiflorum*, (b) *Polianthes tuberosa*

Found in the southwestern Chinese foothills of the Himalayas, jasmine is a permanent climber plant. These days, this nation and India rank among the top producers of jasmine worldwide. It is widely grown in areas with temperate weather. The major nations that grow jasmine worldwide are depicted in the following diagram (**Figure 2**). China, India and Thailand are the top profiler countries contributing on jasmine. Is there any relation with the “Road of Spices” ([Freedman et al., 2019](#); [Hammouti et al., 2019](#); [Spence et al., 2024](#)). The visualization is more adequate using VOSviewer map indicating 55 countries contributing with at least 5 papers among 134 countries. This finding can be better shown using VOSviewer map. China is indicated by the largest light blue node as the most published, followed by India (mustard node) and Thailand (orange node). The dark blue node shows the US in the fourth position etc. (**Figure 3**). VOSviewer gets more details using the overlay map as function of time. Dark blue color indicates that articles are published around 2000 and those recently by yellow (**Figure 4**).

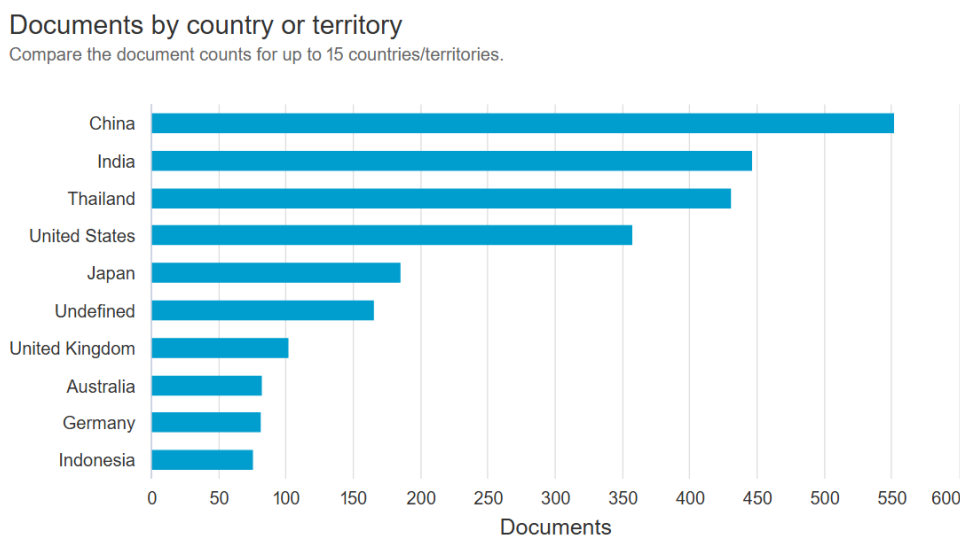


Figure 2: Top countries working on jasmine

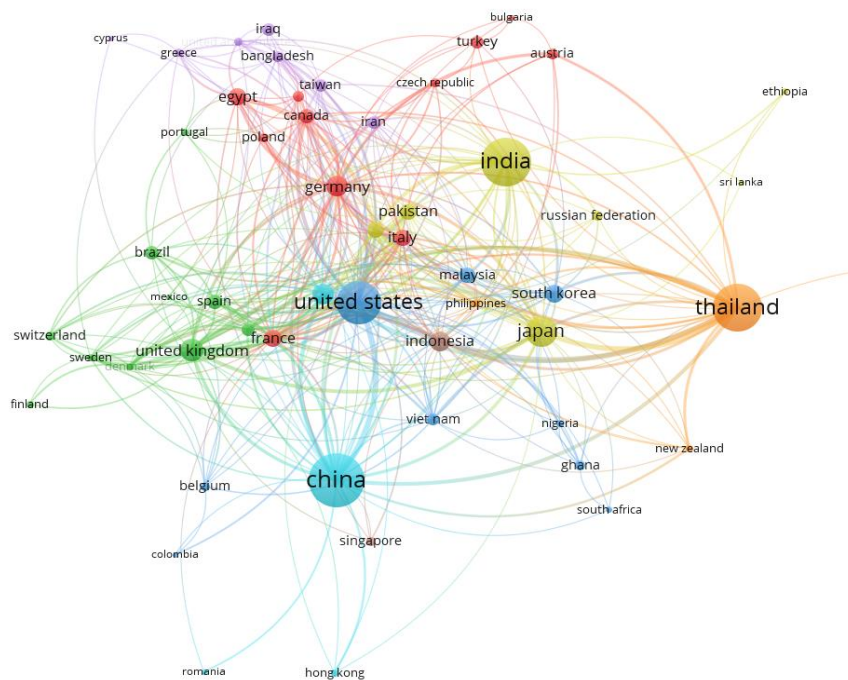


Figure 3: VOSviewer map of countries working on jasmine

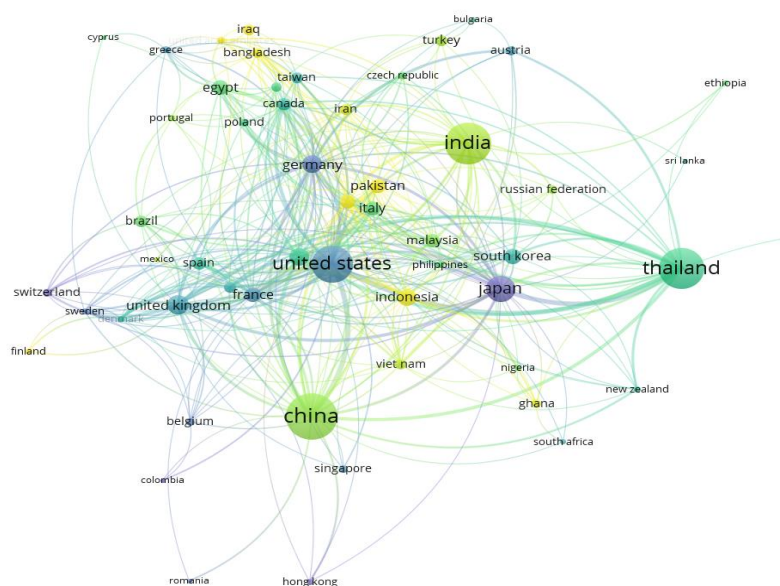


Figure 4: VOSviewer overlay map of countries working on jasmine

Numerous specialists and researchers have focused on the study of jasmine, investigating its botanical properties, therapeutic applications, and potential in the fragrance industry. Their research helps to optimize this plant's culture and transformation while also improving our understanding of it. The top authors who work on jasmine are depicted in the diagram below (Figure 5). The VOSviewer shows the different authors by colored nodes and those with the same color indicates the same team and collaboration (Figure 6). The density presentation in Figure 7 provides the denser yellow on the profiler authors as Gouda, Yamada, Yano, Kobayachi etc...

Documents by author

Compare the document counts for up to 15 authors.

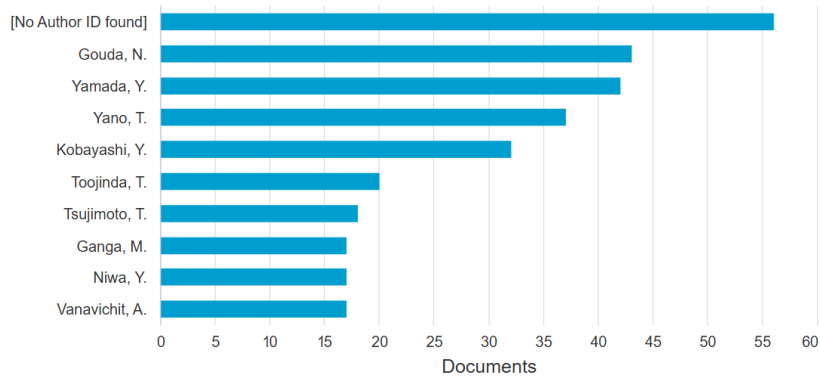


Figure 5: Top authors working on jasmine

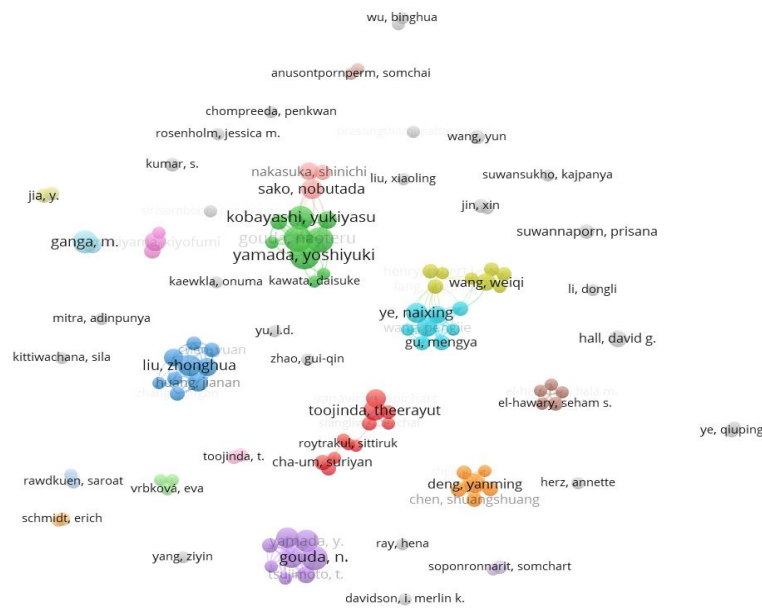


Figure 6: VOSviewer map of authors contributing on jasmine

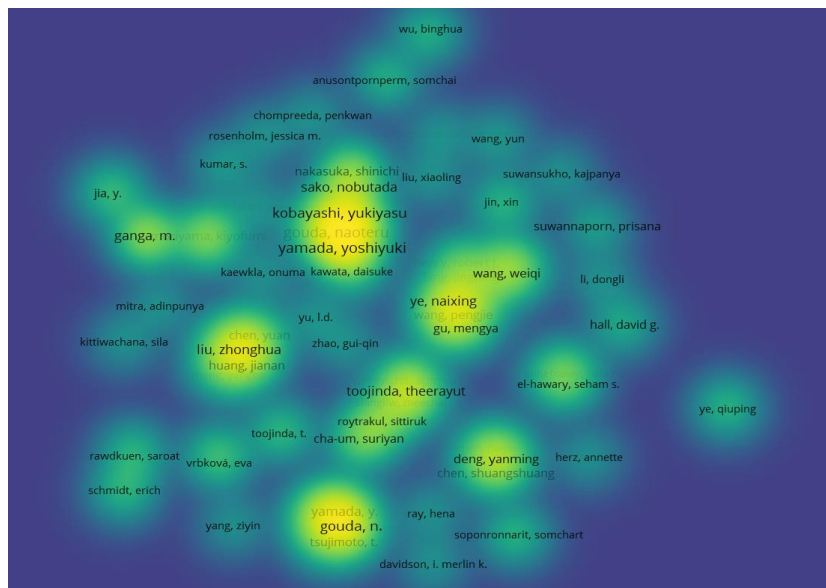


Figure 7: VOSviewer density map of authors contributing on jasmine

3. Structure, Derivatives, and Physicochemical Properties

3.1. Structure

The jasmine lactone is an aromatic compound with the chemical formula $C_{10}H_{16}O_2$, which has an asymmetrical carbon and a (Z) double liaison. Its structure is characterized by a lactone cycle and a cyclic ester (**Figure 8**).

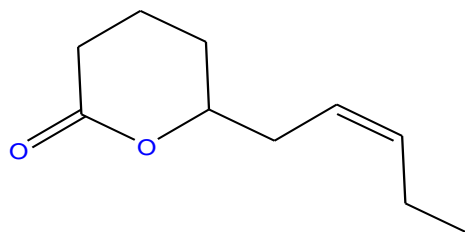


Figure 8: Jasmine lactone structure

3.2. Derivatives

The saturated derivatives, which are created by hydrogenating the double bond of the pent-2-enyl side chain and typically result in fewer effects but creamier and more coconut-like olfactory characteristics, are one significant class of jasmine lactone derivatives (**Figure 9**) (Rowe D, 2009).

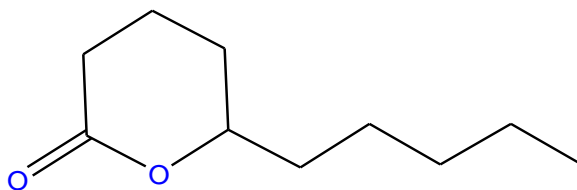


Figure 9: Tetrahydro-6-pentyl-2H-pyran-2-one

Homologated δ -lactones, in which the aliphatic side chain is lengthened or shortened by one or more carbon units, are another classification. These structural variations are well known in lactone chemistry and are linked to changes in odor quality from buttery and milky to tropical or peach-like, demonstrating the strong structure–odor relationships within this chemical family (Berger R.G, 2007).

3.3. Physicochemical properties

The lactone of jasmine is an aromatic compound with the chemical formula $C_{10}H_{16}O_2$. It is an unsaturated δ -lactone made up of a cycle of five carbon atoms with an ester function, one asymmetrical carbon, and a double liaison in configuration Z. It appears as a yellow-pale liquid with a marked floral and fruity odor. It has a molecular mass of about 168.236 g/mol and is poorly soluble in water but well soluble in organic solvents like alcohol and oil. Its transition temperature

is 248 °C, its fusion temperature is between -30 and -10 °C, and it is relatively stable at ambient temperatures, which is actually a useful ingredient in perfume composition (**Table 1**).

Table 1: Jasmine lactone physicochemical properties

Property	Value
Molar mass	168.236 g/mol
Density	0.979-0.989
Boiling point	248 °C
Melting point	-30 °C to -10 °C

4. Synthesis and extraction methods

4.1. Synthesis

A five-step chemical sequence can be used to synthesize jasmine lactone. To create 2-(pent-2-ynyl) cyclopentanone, an enamine is first alkylated using bromopentyne and then hydrolyzed acidically. The equivalent double bond is then created by selectively hydrogenating the triple bond under catalytic conditions. The double bond is momentarily shielded by bromination to produce the dibromo derivative, preventing undesired oxidation of this unsaturation. In accordance with the lactone framework, the cyclic ketone is then transformed into the matching cyclic ester through a Baeyer–Villiger oxidation. Ultimately, a debromination process produces the target molecule, jasmine lactone, by reestablishing the double bond (**Figure 10**) (**Messein, 2010**).

4.2. Extraction methods

There are various methods for extracting this material, such as:

➤ Distillation by entrainment to water vapor

Steam distillation is a traditional and natural extraction technique that uses water vapor to isolate volatile compounds, such as essential oils, from plant materials without requiring organic solvents (**Boukhatem et al, 2019**). In this process, water is first heated in a boiler to generate steam, which is then passed through the plant material contained in an alembic (**Oualdi et al, 2021**). As the steam penetrates the plant matrix, it vaporizes and entrains the aromatic substances. The resulting vapor mixture is subsequently cooled in a condenser, causing the volatile compounds to liquefy. Finally, the essential oil and the hydrosol (floral water) are separated by decantation, allowing for the recovery of the extract in two distinct phases (**Figure 11**) (**Oualdi et al, 2023**).

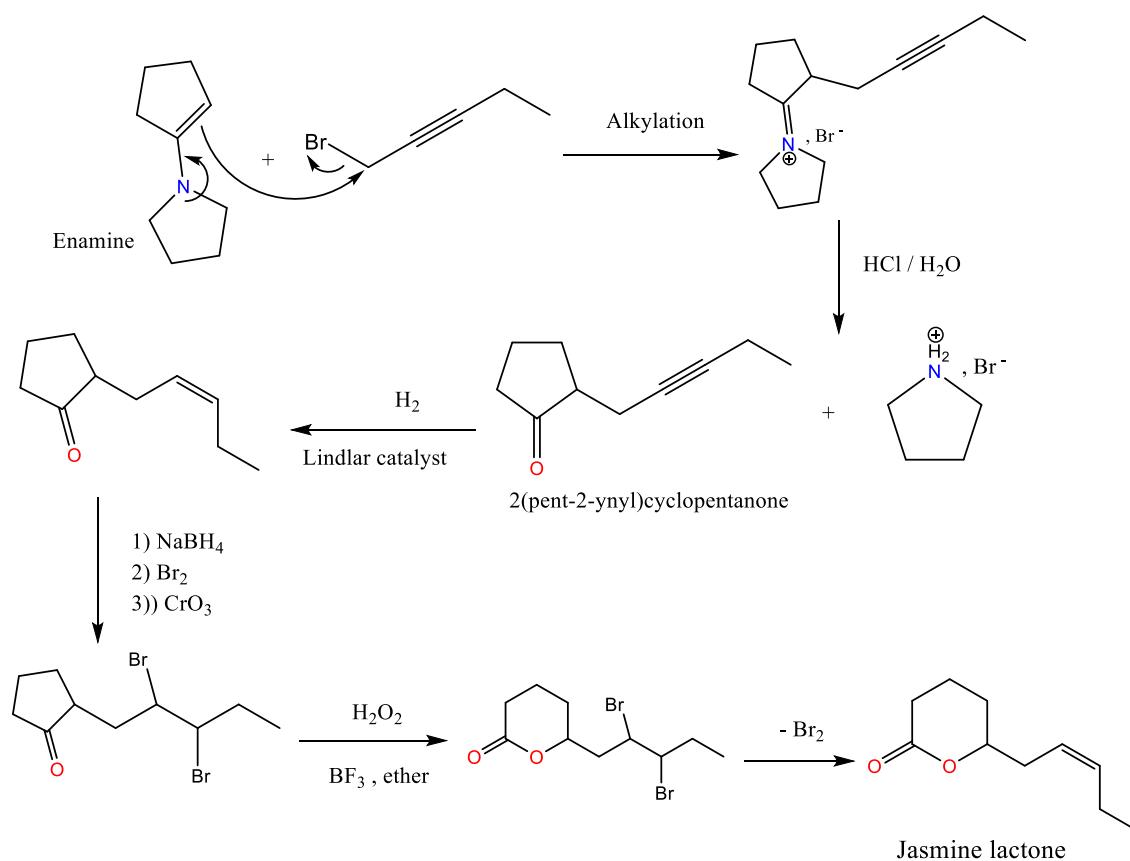


Figure 10: Jasmine lactone synthesis

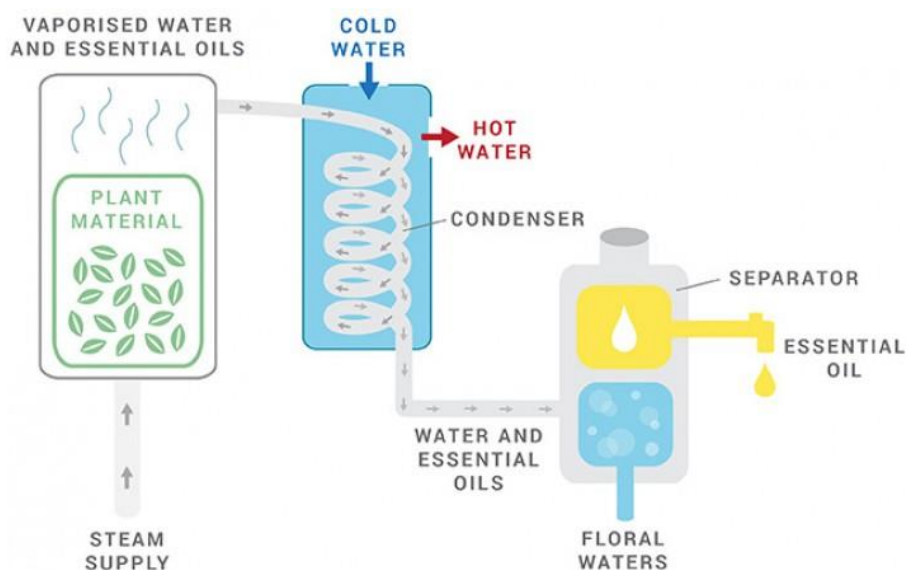


Figure 11: Distillation by entrainment to water vapor

➤ Supercritical CO₂ extraction

Supercritical CO₂ extraction is a modern and clean technique used to efficiently isolate active or aromatic compounds with high yields, without relying on harmful organic solvents (Boukhatem et al, 2019). In this method, the plant material (in this case jasmine flowers) is placed inside the

extraction chamber, while carbon dioxide is heated and pressurized until it reaches the supercritical state. In this form, CO₂ circulates through the extraction chamber and acts as a selective solvent, dissolving the desired aromatic components. The resulting mixture is then transferred to a separator, where the pressure is reduced, allowing the CO₂ to return to its gaseous state and separate from the extract. Finally, the aromatic extract is recovered by decantation and the CO₂ is collected and recycled for reuse (Figure 12).

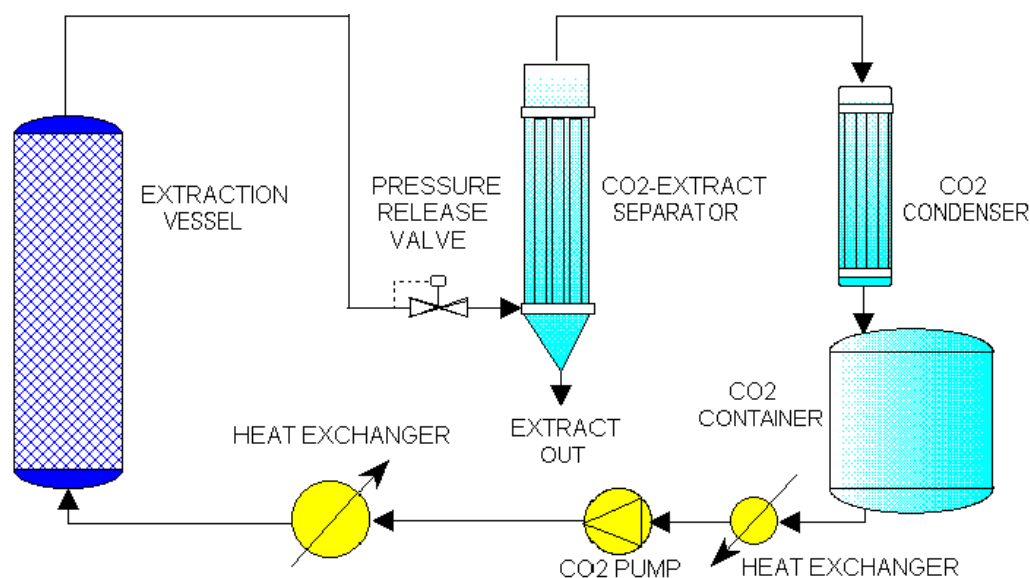


Figure 12: Supercritical CO₂ extraction

5. Production and Applications of Jasmine Lactone

5.1. Advances in Jasmine Lactone Production

The production of jasmine lactone has increased significantly since it was discovered, mostly as a result of developments in microbial biosynthesis and biotechnology. The growing need for natural substances in industries like agriculture, cosmetics, and perfumery has encouraged this growth. These improvements have increased production's sustainability and efficiency, satisfying the increasing need in a variety of industries. Large-scale manufacturing has also been made possible by the improvement of production techniques, increasing the availability of jasmine lactone for a variety of industrial uses (Figure 13). The first paper added on Scopus dated in 1927 about “the odor and structure of certain cyclic acetals” (Read *et al.*, 1927), and the high cited one (1023 citations), treated the bactericidal activities of some plants (Friedman *et al.*, 2002). Among 3152 articles collected from 1927 to now, only 2914 are gathered between 2000 and 2025. Figure 14 indicates an increase of the article number to reach about 260 in 2025.

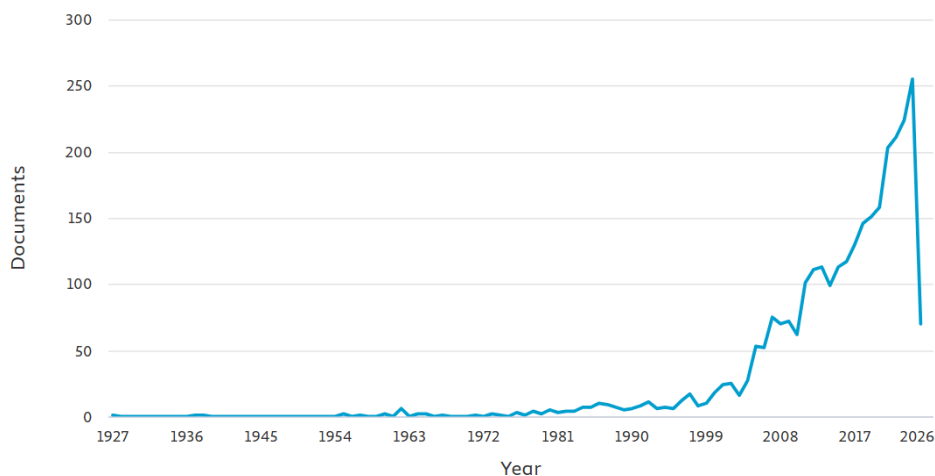


Figure 13: Scientific production on Jasmine (1927-2025)

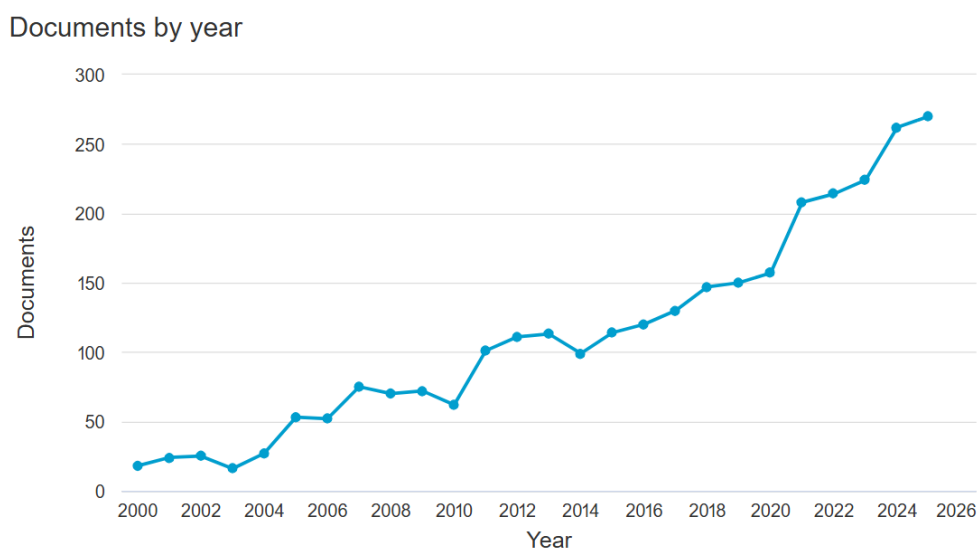


Figure 14: Scientific production on Jasmine (2000-2025)

5.2. *Multidisciplinary Applications of Jasmine Lactone*

Due to improvements in biotechnology and microbial biosynthesis, as well as the increasing demand for natural components in fragrance, cosmetics, and agriculture (Winter et al, 1962), Jasmine lactone production has increased significantly in recent years. As a result, the compound is now widely available for industrial application thanks to more effective and sustainable production techniques. Its applications include biochemistry (9%), where it functions as a signaling phytohormone (Wasternack et al, 2017); agriculture (19.3%), where it supports in plant defense against insects (Howe and Jander, 2008); and medicine (8.8%)/pharmacology (5.8%), where structurally related jasmolactones have demonstrated potential therapeutic properties, even though jasmine lactone itself has no officially recognized medical use. (Blaser F et al, 1991). Jasmine

lactone is used as a model for researching the synthesis and purification of natural lactones and is valued in chemistry (7.2%) and application industries for its fruity and flowery notes in food flavoring and perfumes (Surburg and Panten, 2016). Furthermore, its ability to degrade, low toxicity, and utility in green chemistry techniques are reasons for environmental interest (Figure 15) (Clark et al, 2008) (Silva et al, 2021).

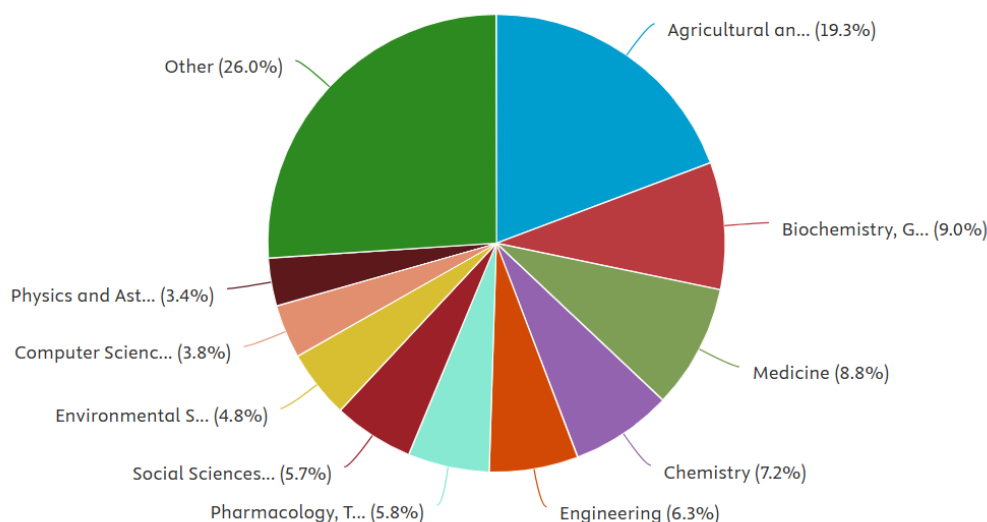


Figure 15: Areas of application for Jasmine

6. Conclusion and perspectives

In conclusion, jasmine lactone, which was first discovered to contribute to the unique jasmine aroma, has developed into a molecule with a wide range of applications in a variety of industries, including biotechnology, agriculture, and cosmetics. Jasmine lactone has new opportunities thanks to this technological advancement, especially in industrial sectors where there is a growing need for natural and ecological additives. The need to significantly enhance the sustainability of jasmine lactone production through the use of eco-friendly strategies and optimizing the effectiveness of biosynthetic processes is one of the next problems. Long-term, integrating this chemical into more ecologically friendly manufacturing systems may facilitate the shift to more sustainable industrial practices while satisfying the growing need for natural and biologically active substances.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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