Vanilla: The Enduring Global Flavour of Innovation

Richa Nahar, Rinkal Dhiman and Richa Salwan
College of Horticulture and Forestry, Dr. YS Parmar University of Horticulture and Forestry, Neri, Hamirpur (HP) 177 001
*Corresponding Email: richaihbt332@gmail.com

Abstract

Vanilla is popular globally across food, beverage, pharmaceutical, and cosmetic industries, particularly for its ability to enhance sweetness. Vanilla acts as a masking agent as it often interacts to make the unpleasant notes undetectable, making plant-based foods more appealing to consumers. Natural vanilla is expensive because it requires manual, painstaking, and time-consuming labor for its production. The global market of vanilla production is dominated by Madagascar, but other countries also contribute and represent the spectrum of ranging from smoky to floral. Besides applications in dairy, baking, savory and other food dishes, vanilla also offers significant health-promoting properties.

Keywords: Vanillin, food, flavour, aroma, beans, therapeutics

Introduction

Vanilla is considered as the "queen of flavors" and ranking as a staple in desserts, beverages, and dairy for centuries. It acts as a primary flavor and also enhances or balances other flavors without dominating them. Unlike simple sugary flavors, vanilla has a complex aroma comprised of over 200 compounds, provides a rich and creamy sensory profile. The primary compound responsible for its signature taste is vanillin, a phenolic plant compound with antioxidant, anticancer, anti-inflammatory, and neuroprotective properties. Plant based proteins often have unpleasant, bitter, off-notes which are generally disliked by consumers. Vanilla is highly effective in removing "chalky" or "dry" textures, making functional health foods creamy and palatable. Vanilla is one of the world's most expensive spices, highlighting its high-labor, time-intensive, and complex production process. It explains the multi-year cultivation, delicate hand-pollination of every flower, a nine-month maturation period, and a lengthy curing process. The immense human efforts and long, delicate, time-consuming production process makes vanilla most expensive spice in the world.

The Journey from Orchid: Regional Sourcing and Flavor Profiles

Vanilla planifolia is the only species within Orchidaceae family which is widely cultivated for its edible fruit. While native to Mexico, it is now primarily grown in tropical regions like China, Indonesia, and Madagascar. Origin of the vanilla bean is responsible for its tailored flavor profile. Madagascar offers standard, classic "Bourbon" flavor sweet, creamy, and slightly fruity (like raisins). Uganda offers a rich, creamy taste combined with "balsamic" notes, which implies a deeper, slightly woody, or complex sweetness. Indonesia is known for a bold, woody, and smoky flavor and works well with strong flavors like chocolate or rich dairy. Papua New Guinea is known for producing a "marshmallow-like", floral and fruity aroma. Vanilla is native to Mexico which is known for a smooth, woody and spicy flavor.

Market Challenges

Vanilla is very expensive because consumers demand for organic and sustainable sources. Most vanilla comes from Madagascar, which makes the supply limited due to storms, politics, and crop diseases. To meet the global demand, manufacturers mix pure vanilla with cheaper natural ingredients that boost the flavor. This allows them to make more products, like ice cream, without needing as much of the expensive pure vanilla. Manufacturers also use vanilla in combination with other flavors paired with earthy flavors (turmeric, matcha), floral notes (hibiscus, lavender), complex savory sauces complementing with cardamom and nutmeg. Natural vanilla derived from the *Vanilla planifolia* orchid is considered the highest quality for flavor and aroma but is labor intensive. Approximately 99% of the vanilla flavor used globally is synthetic due to cost and supply shortages. Synthetic vanilla is primarily produced from guaiacol (a petroleum byproduct) or lignin (a wood pulp byproduct). Synthetic options are cost-effective but lack the complex antioxidant properties and health benefits of pure natural extracts.

Industrial formulations of vanilla

Vanilla is processed into three distinct physical forms to incorporate it into different types of products without causing production issues. Vanilla is available as liquid, spray-dried powders, and cocoa butter carrier formulations (Table 1). Various advanced technologies are designed to augment mouth feel and creaminess in sugar-reduced formulations to help rebalance the flavor and sensory characteristics.

Table 1. Distinct forms of vanilla and their advantages in various food products

Form	Physical State	Food products	Main Advantage
Liquid	Liquid	Beverages, Dairy	Instant dispersibility
Powder	Dry Powder	Dry Mixes, Snacks	Heat stability & long shelf life
Cocoa Butter	Solid/Fat	Chocolate	Texture compatibility

Given the limitations of natural vanilla production, the market utilizes several alternative formulations ranging from chemical substitutes to blended natural products. Alternative vanilla formulations include:

Vanilla extract primarily consists of synthetic vanillin dissolved in water and 35%alcohol, often with added caramel coloring, sweeteners like corn syrup, and preservatives. It is widely used in mass-produced baked goods, cookies, and cakes because it is heat-stable and is often supplemented to lotions, body washes and perfumes.

Vanilla essence is a synthetic, cheaper alternative made from petrochemicals precursors like guaiacol and glyoxylic acid, which lacks a complex flavor.

Vanilla powder: Whole, cured vanilla pods are dehydrated and finely ground into a powder which is ideal for dry mixes, spice blends, and light-colored frostings where liquid extract might change the color or consistency.

Vanilla paste is a blend of concentrated vanilla extract, vanilla bean seeds, and sugar syrup (such as corn syrup). It is used for desserts such as ice cream, and custards where the visual appearance of vanilla specks is desired.

Vanilla syrup is s a sweetened liquid which is prepared by boiling sugar, water, and vanilla together.

Vanilla essential oil and oleoresin are prepared by mixing vanilla with carrier oils (like almond oil). It is frequently used in in skincare, perfumes and aromatherapy to relieve stress.

Application of vanilla in health

Vanilla has long been used in therapeutic applications including culinary and medicinal remedy (Table 2). Modern research has validated these ancient claims by focusing primary bioactive compound i.e., vanillin, found in vanilla.

Table 2. Overview of traditional and scientific medicinal insights

Feature	Traditional use	Modern scientific insight
Aroma	Calming, nerve stimulant	Reduces anxiety, calms new-borns
Flavor/Ingestion	Aphrodisiac, digestive aid	Potential antioxidant, anti-inflammatory
Medicinal Use	Treat fever, spasms	Neuroprotective, anti-sickling

Vanilla is used for extensive applications in health:

1. **Neurological and calming effects:** Vanilla is known to have a significant calming effect attributed to the main aromatic compound, vanillin which stimulates the brain to release endorphins, generating feelings of pleasure and relaxation, boosts levels of serotonin and dopamine, which helps reduce anxiety and depression symptoms. It triggers associative calming by reminding the brain of safe, pleasant memories. In adults, the scent of vanilla can diminish the body's automatic "startle reflex" when exposed to sudden, loud noises. It has a relaxing effect that can lower claustrophobia during stressful situations like MRI scans. Similar to its effect on infants, vanilla may help reduce the severity of sleep apnea in adults by modulating stress responses and respiratory patterns during sleep. Exposure to familiar scents like vanilla significantly decreases crying and grimacing (facial expressions of pain) during stressful medical procedures, such as blood sampling. It helps reduce motor agitation (excessive moving) and helps newborns balance their physiological systems during pain. In premature neonates, the scent of vanilla helps in regulating temporary cessation of breathing, reducing apnea, and preventing bradycardia (slow heart rate).
2. **Metabolic effects:** Besides flavouring agent, vanilla is a powerfool option in formulating diets with low sugar content and metabolic health. By adding vanilla to foods that typically require a lot of sugar (like yogurt, milk, or desserts), the perceived sweetness is boosted. This allows manufacturers or individuals to reduce the actual amount of sugar added to the food without making it taste less sweet to the consumer. Studies conducted on mice fed high-fat diets found that supplementing their diet with vanillin produced positive metabolic changes such as improved insulin sensitivity, increased glucose tolerance and lower body weight.
3. **Anti-inflammatory and antioxidant properties:** Vanillin and vanillic acid act as scavengers for free radicals that cause "oxidative stress" a type of cellular damage that breaks down cells over time. These compounds can cross the blood-brain barrier to protect brain cells from oxidative damage, which is a major factor in neurodegenerative diseases like Alzheimer's and Parkinson's. These compounds can also prevent liver damage caused by toxins by maintaining healthy antioxidant enzyme levels. Vanillin inhibits the biological pathways that cause persistent, harmful inflammation in the body. Vanillin reduces the production of such as IL-6 (Interleukin-6) and TNF-α (Tumor Necrosis Factor-alpha) that trigger inflammation. Vanillin acts as an inhibitor of NF-ϰB (Nuclear Factor kappa B) pathway, which is a master switch for turning on inflammation. Vanillin has reduced skin thickening, scaling, and the excessive infiltration of immune cells associated with psoriasis.
4. **Traditional and alternative remedies:** Pure vanilla extract typically contains a high percentage of alcohol (often around 35%). When applied topically, this alcohol content acts as a mild numbing agent on the gums and teeth, providing temporary relief from pain.

Due to its scented components, it is sometimes used as a natural alternative in homemade (DIY) bug repellents. In laboratory studies, oral administration of vanillin has been shown to reduce pain caused by nerve damage (neuropathic pain) or inflammation

Applications of vanilla in food industry

Vanilla is a highly popular and favored flavor and aroma known for its widespread use in various industries. Due to its popularity in food, beverages, and cosmetics, vanilla is the second most expensive spice in the world, surpassed only by saffron. It is commonly known for its role in sweet desserts, it also has the ability to mask off-flavors and add versatility in savory dishes and other products.

i. **Dairy and frozen desserts**: It acts as a base flavor for ice cream, yogurts, and smoothies, and can help make reduced-sugar dairy products more palatable.

ii. **Bakery and confectionery**: It adds warmth, aroma, and a "buttery richness" to cakes, pastries, and cookies. For commercial baking, vanilla is mixed with heat-stable ingredients to withstand high temperatures.

iii. **Savory and blends**: Vanilla is increasingly utilized in savory cooking not merely for sweetness, but as a sophisticated flavor enhancer that adds depth and balances acidity. It is used in soups, sauces, stews, and marinades, craft beverages and cocktails.

iv. **Functional foods**: Vanilla is specifically employed to mask the bitter, chalky, or metallic tastes of botanical extracts, amino acids, and plant proteins like pea or soy. Encapsulated formulations are also in demand which allows for the controlled release of the flavor.

Conclusion

Vanilla is very popular and costly spice in the world, finding applications in food and health. Besides its flavour, it is also utilized in functional foods for enhancing sweetness and reducing sugar content. Therefore, vanilla is in high demand for healthy, clean label products meeting the consumers' demand.

Acknowledgements

The authors acknowledge College of Horticulture and Forestry, Neri for providing necessary infrastructural facilities.

* * * * * * * * *