

Vanilla's Perpetual Crisis

Understanding the factors that play crucial roles in supply chain instability.

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orldwide consumption of vanilla is somewhere around 2,000-2,500 MT per year. Madagascar produces about 65% to 70% of the total bean supply. The vanilla industry has gone

through several bean shortages and sharp price hike episodes throughout its history. Some of these crises lasted for a long time, while others were temporary. Some were due to natural disasters, some were man-made, and others a hybrid of natural and man-made. All of them adversely affected vanilla growers, the vanilla processing industry, users and consumers.

Every crisis contributed to the proliferation of vanilla substitutes, increased adulterations of natural materials, skirting of vanilla regulations and questionable labeling of the products. Each major crisis resulted in a 40% to 50% decline in natural^a vanilla usage in foods and ice creams. Demand for pure vanilla gradually increased following each crisis in tandem with restored supply of beans and a plunge in bean prices. This rebound usually was due to usage of vanilla in new products. However, substantial usage of pure vanilla remains permanently lost to vanilla substitutes.

The Latest Challenge

The current crisis in the vanilla industry began in 2015, less due to bean shortage than to irrational buying patterns and general lack of transparency in the market.¹

At that time, Madagascar could supply between 1,500 MT and 1,800 MT every year, which is typical. However, exaggerated claims of crop destructions due to cyclones and bad weather inspired hoarders and money-launderers from the illegal rosewood trade to buy whatever vanilla beans they could purchase, regardless of quality, and thereby grabbed most available beans. That created a shortage in the market and started driving the bean prices higher and higher.

The longer hoarders sat on their beans, the higher the price went. Many big international companies could not change their product formula without extensive planning. This takes time, and thus these companies were forced to buy vanilla bean-based flavorings at whatever the prevailing market price of the beans. Even with sufficient crop, prices for Madagascar beans reached \$600 per kilogram by 2018.



Announcements in 2015 by international food, beverage and confectionary giants like Nestlé, General Mills, Hershey, Kellogg's, etc., to shift to "clean label" initiatives—thereby implying the use of only natural flavors and ingredients in their products—compounded the problems for this vanilla crisis. For the products containing vanilla flavor, it specifically meant the removal of synthetic vanillin from these products.

It was clear then that many multinationals were going to replace synthetic vanillin with vanillin made by processes such as fermentation; at the same time, an increased number of fermentation-derived vanillins were getting FDA approval as natural flavor^b. In theory this should have had little effect on the prices of vanilla bean-based flavors.

These vanillins did not use vanilla beans for their manufacture—hence, no increased demand for beans. But this "natural" bandwagon triggered irrational bean buying, bean hoarding and entry of speculators in the market, which drove up prices. In the opinion of people intimately associated with this market, the vanilla bean sector is now in the hands of a few powerful players who control the supply and prices.

Meanwhile, political instability and lack of unsustainable governmental price controls in Madagascar continues to prolong the crisis. Is there something that can be done to prevent future crisis? It will be helpful to understand various factors that play crucial roles in creating the crisis in the first place.

^aFor details on the vanilla standard of identity, see "Labeling Vanilla Flavorings and Vanilla-Flavored Foods in the United States" in the May 2018 issue of *Perfumer & Flavorist*, Page 34; https://perfumerflavorist.texterity.com/perfumerflavorist/may_2018/

^bPer the previously cited article, "Regarding vanillin produced using a fermentation process, FDA stated that the common or usual name for this material is "vanillin" and that it should be labeled as "vanillin derived naturally through fermentation."



The vanilla market in Madagascar has been impacted by the adoption of natural flavors and climate change.

Climate Change

Global warming has drastically changed weather patterns and ferocity of the cyclones. Widespread devastation of vanilla crops due to severe weather and climate has occurred at least twice in the last 20 years. In Madagascar, cyclones Hudah and Gafilo at the beginning of 21st century, and cyclone Enawo four years ago, reduced the crop size by more than 40% in each case.

Cyclones like Hudah and Enawo may occur with rapid frequency due to global warming and climate change. Local storms and unexpected heavy rains or drought conditions have occurred in other vanilla growing areas from time to time, resulting in the loss of vanilla vines and reduced bean production. New plantings take from three to four years to be productive, making it difficult to recover quickly.

Improper Vanilla Cultivation Practices

Good quality cured vanilla beans come from green vanilla beans that are harvested at full maturity, which is about nine months after the vanilla flowers are pollinated. These cured beans easily yield 1.5% to 3% vanillin, depending upon the geographic area where they are grown and how they are cured. Fully

mature green beans contain about 85% moisture and, upon curing, can yield about 18% cured beans.

Unfortunately, during vanilla crises, growers start harvesting the beans much earlier than their maturity to satisfy the market needs. If there are buyers for green beans, mature or not, many small farmers are happy to harvest them after only five to six months on the vines. These beans, upon curing, have no vanillin, have very weak vanilla aroma and taste, and yield no more than 8-9% cured beans.

Crime

Theft of beans is another scourge in many growing areas. This puts added pressure on the growers to harvest the beans before they are mature and take advantage of higher prices, or risk losing the beans to criminals.

Fluctuating Prices

On the other hand, when the bean prices drop precipitously, many growers neglect vanilla and plant other crops, which bring much needed cash for sustenance. Over time, this contributes to vanilla bean shortages and exorbitant prices, perpetuating the diminished demand cycle.



Vanilla crises put added pressure on growers to harvest the beans before they are mature.

Vanilla bean prices recently declined from their peak of around \$600 per kilogram in 2018, to around \$200 per kilogram in 2020. With substantial crops in 2018 to 2020 in Madagascar and other global vanilla growing regions, lower demands for pure vanilla and availability of cheaper natural substitute flavors, it is not difficult to predict much lower vanilla bean prices ahead. As long as unscrupulous buyers, speculators and greedy dealers do not hoard the beans, there is a potential for the bean prices to drop to \$50 per kilogram or lower. The situation will soon become unsustainable and thus will begin the next cycle of crisis.

Vanilla Diseases

Plant diseases are common afflictions of plants under excessive, prolonged rainy conditions, poor soil drainage and heavy shade. Plant diseases such as stem rot, stem blight, root rot, bean rot, shoot tip rot, leaf rot, inflorescence rot, premature bean yellowing, anthracnose, horsehair blight, black crust disease, vanilla mosaic virus and vanilla necrosis potyvirus can affect vanilla under these conditions. Stress placed on the plants by excessive pollination also plays a significant role in fostering vanilla diseases.

Phytophthora (black rot), *calospora* (anthracnose), *Sclerotium rolfsii* (root rot), *Colletotrichum vanilla* (shoot tip rot), *Fusarium oxysporum* and *Fusarium batatis* are fungi that cause common vanilla diseases. *Fusarium* is known to wreak havoc within vanillaries in growing areas. *Fusarium* played a significant role in Madagascar's 2002-2004 vanilla crisis, alongside Cyclone Hudah. The fungus is difficult to eradicate and can fester for years. It afflicted Indian vanilla growers in the last decade and almost wiped out all vanilla bean production there.

Vacuum Packaging

The practice of vacuum packaging of green and semi-cured green beans began in Madagascar around 2013 to prolong their storage life before curing. In the past, bean collectors mainly collected beans and sold them to the curers, and the beans were promptly cured to produce the article of commerce. The idea of vacuum packaging green beans was at once misused by the greedy speculators and some bean curers and suppliers. They hoped that they could sit on these vacuum packaged beans as long as they needed to and shop around for best price. This strategy was successful, to some extent, in driving

the bean prices higher, and the strategy worked particularly when the crop was smaller than expected.

Vacuum packaging of semi-cured beans was practiced not only by bean collectors, but also by speculators and unscrupulous curers. Speculators and curers created temporary shortages by hoarding semi-cured beans and drove prices up during vanilla crisis.

Once introduced to the idea, collectors and some curers continued the practice even when the vanilla crop was substantial. Due to the lack of total scientific understanding of the consequences of storing non-sterile, semi-cured beans under vacuum, very poor-quality beans were produced upon their subsequent curing. Many of these players also held semi-cured beans in vacuum packages long enough for the beans to produce off odors and strong phenolic notes.

It soon became clear that the practice was faulty. The chemicals responsible for the development of phenolic notes like guaiacol, p-vinylguaiacol, phenol, cresol and p-cresol are produced under low oxygen conditions in the presence of microorganisms. Toxic beans can be produced under these conditions. Vacuum packaging creates anaerobic conditions in the package, in which pathogenic bacteria like *Clostridium botulinum* can grow and potentially produce cured beans containing neurotoxins.²

Role of Natural Vanillin

Vanillin is an important component of vanilla's flavor, which is a mixture of more than 200 individual volatile and non-volatile aroma chemicals. Properly cured vanilla beans yield about 2% vanillin upon exhaustive extraction. Numerous efforts have been made to increase this yield, with limited success. Vanilla bean-based vanillin is therefore very expensive, costing several thousand dollars per kilogram.

With successful production of vanillin from non-vanilla bean natural sources and natural processes such as fermentation, we now see numerous offerings of "natural vanillin" in the market. These vanillins, although much more expensive than synthetic vanillin, are much less expensive than vanillin isolated from vanilla beans.

The Food and Drug Administration, however, recognizes only vanillin derived from vanilla beans as "natural vanillin." Vanillin made from natural raw materials and natural processes must be called "natural flavor" or simply "vanillin." This vanillin can be used to boost or modify natural profiles, such as any fruit or chocolate flavors.

The product can be labeled as "flavored with natural flavor" as long as the natural flavor does not

imitate vanilla flavor. In the case of vanilla flavorings, which have a U.S. federal standard of identity, if non-vanilla bean vanillin is added to boost the flavor, it makes the product natural and artificial. Such a product's proper declaration is "natural and artificial vanilla flavor," even if the added vanillin is considered a natural flavor.

Consequently, foods flavored with vanilla flavorings made with added vanillin must declare on the ingredients list as "natural and artificial vanilla" or "vanilla-vanillin flavor" (21CFR 169.180). After a careful look at the ingredient labels on many foods on the market, it is obvious that this regulation is often overlooked, knowingly or unknowingly.

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Natural Vanillin

There are several raw ingredients which can be used for manufacturing natural vanillin. Ferulic acid isolated from rice or wheat bran can be converted into vanillin by fermentation. Curcumin from turmeric can be catalytically converted into vanillin and is considered a natural flavor in the United States, and so is vanillin made from clove-oil-derived eugenol. Vanillin is also produced by yeast fermentation of sugar in a process called synthetic biology, or "synbio."

Synbio vanillin is considered a natural flavor both by the United States and European Union regulations. However, proper labeling of this product will not be determined until 2022. Swiss company Evolva, a developer of synbio vanillin, aspired to improve the manufacturing efficiency of this vanillin to the extent that its price would approach the price

of synthetic vanillin. Currently, about 15,000 tons of synthetic vanillin is produced annually at a price of \$10-20 per kilogram.

Vanilla-Vanillin Confusion

Most vanilla beans are used for making vanilla extracts, oleoresins and absolutes. A small percentage of the beans are also used in gourmet cooking. Only one third of the flavor strength of vanilla is attributed to its vanillin content. That means the major strength of vanilla flavor is attributed to the non-vanillin components of the beans.

There is considerable misunderstanding about vanilla and vanillin. Many articles written on the subject conflate vanilla, a vanilla bean-based complex flavor, and vanillin, which is a single chemical entity that is a part of the total vanilla flavor.

This lack of understanding of complex vanilla flavor creates confusion about the actual amount of vanillin produced per year from vanilla beans—a total that is negligible.

It is important to state here that vanillin tastes the same whether it is made by chemical synthesis, produced from ferulic acid or sugar by fermentation. It is also true that vanillin alone, no matter how it is

produced, will never taste like the complex vanilla flavor obtained from vanilla beans. It is very easy to enhance the vanilla flavor of a product with the addition of non-vanilla bean vanillin if you accept the dilution of true vanilla character in the product. It is, however, legally not allowed unless the addition of non-vanilla bean vanillin is declared on the product label, according to 21CFR 169.180.

Many consumers, who want foods flavored with vanilla flavor from vanilla beans only, are willing to pay more for that privilege. Due to unscrupulous practices of many food manufacturers, vanilla-flavored products are flavored with small amounts of real vanilla to which non-vanilla bean vanillin is added and listed as natural flavor.

Misuse of Natural Vanillins and Regulations

A survey of the chemical analysis of vanilla-flavored foods in grocery stores conducted by a firm known to this author reveals that many of these products are flavored with vanilla flavorings with added non-vanilla bean natural flavor (vanillin). Added natural flavor (vanillin) is considered a natural ingredient in the flavor market. Those familiar with vanilla regulations should know that such products do not conform to the standard of identity for vanilla products. Often these products are sold in containers with pictures of vanilla beans or flowers, suggesting that the vanilla flavor is from vanilla beans, though the major component of the flavor did not come from vanilla beans.

Companies that are engaged in deceptive practices are aware that the FDA has limited resources to address these indiscretions. To make matters worse, the FDA's rulings on natural vanillin from non-vanilla bean sources can be confusing, which may allow unscrupulous users to circumvent the regulations, knowingly or unknowingly, regarding proper use and labelling of these vanillins.

In its regulatory correspondence, the FDA has stated that vanillin produced using methods consistent with the FDA definition of "natural flavor" (21CFR101.22(a)(3)) can use the term vanillin or natural flavor, if it does not connote natural vanilla flavor, since it is not from vanilla beans. The FDA has also proclaimed that the common or usual name for vanillin produced through the fermentation process is "vanillin," and should be labeled as "vanillin derived naturally through fermentation." Labeling for this vanillin should not imply that this vanillin is a natural flavor, and it cannot be used to make natural vanilla flavors or imply that the finished flavor containing this vanillin is natural.



Vanillin can be used to boost or modify natural flavors.

It is clear from these statements from the FDA that no vanillin, made whether by natural process or fermentation process, should be used in products whose labels give the impression that the product is a natural vanilla-flavored food.

Unfortunately, when the vanilla bean prices skyrocket during a crisis, it makes sense for the users to substitute expensive vanilla bean-based flavors with alternatives, which are made with a combination of botanical extracts and natural aroma chemicals.

Not all vanilla users understand the composition and origin of aroma chemicals in their flavors. This results in lower consumption of pure vanilla and increased usage of cheaper adulterated or lower-quality vanilla products. When bean prices decline substantially in the years after a crisis, the demand for pure vanilla starts to increase. As previously stated, only part of the increase in that demand is due to users going back to their pre-crisis formula. Most users who make the switch during a crisis continue using cheaper substitutes, thereby reducing the demand for vanilla bean-based flavors.

Use and Misuse of Vanilla WONF Flavors

The federal standard of identity for vanilla flavorings does not support "vanilla WONF" designation for flavors made with vanilla flavorings to which other natural flavors are added, including vanillin produced through a natural process (i.e., a process consistent with the definition of natural flavor at 21CFR101.22 (a)(3)). Vanilla WONF flavorings are not always made with only added vanillin, but also with botanical extracts and other natural ingredients such as piperonal, maltol and some anisic compounds. None of these additions conform to the vanilla standard of identity.

Yet, a number of food products currently in the market are sold with vanilla (with other natural

flavors) labels. Analysis of many of these products shows that the flavor consists of a small amount of vanilla flavoring, to which piperonal, maltol, anisic aldehyde and vanillin, all of which are available as natural ingredients, are added. FDA's ruling on this category is confusing or, at best, not clear. For example, as John Hallagan and Joanna Drake (2018)³ state that FDA may not object to labeling a flavoring or a food by listing "vanilla with other natural flavors" provided that the ingredient statement clearly describes the contents of the product. None of the products scrutinized that are labelled Vanilla (with other natural flavors) list other added chemicals to the product including vanillin in the ingredients list.

How to Avoid Future Crisis

Given vanilla's many challenges, there are several remedies available:

- Bean supply stability through fair price for growers
- Strict regulation on vanilla bean derived vanillin and all other natural (nature identical) vanillins
- Stricter implementation of vanilla regulations
- Promotion of use of pure vanilla
- Consumer education in the matter of vanilla regulations

References

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