



# THAI FREEZE DRY

COMPANY LIMITED



## VORTEX FREEZE-DRIED TECHNOLOGY

“Where Nature Meets Science”



Vortex Freeze-Dried Technology (VFD) is a key element in the creation of our functional superfoods and nutraceuticals. This process allows Thai Freeze Dry to preserve whole foods in their fresh form, maintaining the medicinal bioactivity of a live plant while providing the safety of a stable (preserved) commodity. This is essentially freeze-drying but with a dynamic twist. This evolutionary and transitional process provides a highly bioactive, stable, bio-available, and concentrated product that is not subject to microbial or enzymatic spoilage.

VFD is unique in that the motion of the frozen raw materials (flying around in a vortex) and sublimation of the ice structure causes the plant tissue to fracture along the weak points - between the layers of the cell walls sustaining cellular integrity and the bioactive extracellular matrix.

**Exposure of the entire surface area to be dried results in “even” drying which preserves cell wall structure and preserves the biochemical makeup of the plant as it exists in nature.** In addition to higher bioactivity, this process results in porous particles that are easier to absorb and are, therefore, more bioavailable. Higher bioactivity combined with higher bio-availability make all of our VFD bio-activate botanicals significantly more effective.

We describe Vortex Freeze-Dried Technology as **“transitional” and it is, in fact, part of a wave of transformation** that challenges us to change the way we view our place in nature and the relationship between our physiology and our consciousness.

The analysis and measurement of targeted chemical compounds is a valid analytical tool, but does not **fully explain the body’s adaptive mechanisms**. Vortex Freeze-Dried Technology takes you beyond the chemistry per se. VFD takes a holistic approach that includes the subtle mechanisms of nature operating with intelligence through patterns of association and encoded information.

The healing message is not carried by one or several ingredients alone. The healing message is effectively delivered when we sustain the synergy of the complex cellular, extracellular, and molecular structure of our bioactive botanicals as they exist in nature.

VFD sustains this complex structure which comprises the context which defines how the ingredients work in synergy designed by Nature –**the “Master Formulator.”** **If you were to create a molecular map** of the plant as it grows in nature and compare this to a molecular map of the finished powder you would want these to be as close to one another as possible. At the most basic level this is the goal of VFD and the reason why the efficacy and experiential nature of our products are superior.

## CONVENTIONAL FREEZE DRYING:

**Freeze drying uses a natural process called “sublimation” that has been used for centuries.** High in the Peruvian Andes, the Incas preserved their potatoes and vegetables by burying them in the snow. The freezing temperatures and high altitude (low atmospheric pressure) effectively preserved their food through sublimation.

During the process of sublimation water in liquid form passes into water in gas form (water vapor) which naturally moves toward a colder temperature where it solidifies (ice). The water never passes back into its liquid state.

**In a modern freeze dry machine the product is flash frozen in a vacuum inside the “product chamber.” The product chamber is connected to a second much colder condensing chamber called the “ice chamber”.** Water (in vapor form) moves by sublimation from the product chamber into the colder condensing chamber where it solidifies as ice. The moisture being moved from the product chamber into the ice chamber includes the moisture contained in the products, and in this way the products become dried while they remain frozen.

Most herbs and botanicals are designed by nature to degrade once they are harvested. The enzymes and microorganisms that naturally degrade our herbs and botanicals require water. If we remove the water, the herbs and botanicals are preserved. However, if we use heat to remove the moisture the heat will denaturize the enzymes (making them ineffective), oxidize thermo-sensitive ingredients including vitamins such as C and beta-carotene, and result in CIS to TRANS conversion of essential oils and fatty acids. Elimination of the water without exposure to heat preserves the enzymes, vitamins, minerals, essential oils, fatty acids and other vital bioactive compounds.

During the freeze dry process the moisture inside the product takes a path from the liquid phase to the gas phase (water vapor) and is then removed as water vapor which goes directly into the solid phase (ice) without crossing back to water. When water is removed in its liquid state by exposure to heat the liquid is removed at a finite rate while the quantity or volume of liquid steadily decreases. When this

happens surface tension in the liquid body pulls against any solid structures in contact with the liquid. Delicate structures such as cell walls tend to be broken apart by this surface tension between liquid water and the cell walls.

Freeze drying avoids this surface tension by removing the water in its gas state rather than in its liquid state and thereby preserves cellular integrity.

The scientific community has long recognized that the freeze dry process is the best method for the preservation of bio-active materials. Freeze drying became well known near the end of WWII when it was used to transport blood plasma to soldiers on the front lines. When snake venom is collected to make anti-venom it is freeze-dried. Most scientific laboratories have a small freeze dry machine to preserve samples without disturbing their chemical composition. Science recognizes the freeze dry process as the most effective method of preservation of bio-active substances including herbs and botanicals.

Please keep in mind that conventional freeze drying where the product to be dried is not exposed to oxidation by heat and in which the water is removed as a gas (water vapor) rather than a liquid is far superior to any drying methods that use heat and remove water in its liquid state. Our intention is not **to “trash” the value of conventional freeze drying, but to take the valid principles and advantages of the freeze dry process to a new and higher level using science and technology.** VFD has been referred to in **the vernacular as “super freeze drying” or as we prefer to say “Premium Freeze Drying.”** While VFD is, in fact, a freeze-dry process, it is evolutionary, transitional and for those heavily invested in the status quo it may be viewed as a **“disruptive technology.”**

## VORTEX FREEZE-DRIED TECHNOLOGY:

Thai Freeze Dry Co. Ltd. has developed an evolutionary and transitional technology that provides the highest quality nutraceuticals, supplements, food ingredients, natural pigments and cosmetic **compounds containing the full spectrum of nature’s bio-active constituents.** It expands our capabilities to provide products of superior quality and exceptional efficacy.

Vortex Freeze-Dried Technology is a dynamic process. The product is dried by sublimation, not while sitting motionless on trays, but while flying around vigorously inside the product chamber. The flash-frozen particles decrease in size due the movement of the super-frozen particles and, even more substantially, as a result of the sublimation of the ice structure that holds the frozen particles together. The material breaks down into increasingly smaller particles along natural cellular fracture-lines. The plant tissue fractures between/along the layers of the cell walls sustaining cellular integrity and significantly improving retention of the extracellular contents.

**In conventional “tray” freeze drying the product sits motionless on trays, one piece of material covering the other.** This exposes only a small part of the total surface area to sublimation at any one point in time. The moisture will exit along the path of least resistance which is through that part of the cell wall **exposed to sublimation. This ‘uneven’ drying scenario, where only part of the surface area to be dried is exposed,** causes all the water in the cell to be funneled through the relatively small exposed surface area subject to sublimation. This can result in damage to the cell walls. The molecular structure loses its shape and the biochemical makeup of the plant you are trying to preserve is changed.

In contrast, Vortex Freeze-Dried Technology, wherein the particles to be dried are flying vigorously in **what might be described as a “whirling vortex,” the entire surface area to be dried is exposed at the same time.** Water (in vapor form) is eliminated evenly thereby preserving cell wall structure.

The cellular and molecular structure of these botanicals are complex. If you were to see a diagram of the molecular structure (a molecular map) as the living plant grows in nature and compare this to the molecular structure of the dried powder you would want them to be as close to one another as possible. Our goal achieved by VFD is to minimize damage or destruction of the cellular structure, preserve cellular and intracellular contents and sustain the biochemical makeup as closely as possible to how the plant exists in nature.

## ADVANTAGES OF VORTEX FREEZE-DRIED TECHNOLOGY

In addition to the substantial benefits of tray freeze drying, VFD provides:

1. Sustained cellular integrity
2. Improved retention of bioactive intracellular contents (extracellular matrix)
3. Increased bioavailability as a result of small particle size and porous particle structure. This increases the exposed surface area per unit of weight resulting in higher absorption
4. Faster and more consistent drying at lower temperatures
5. Sublimation and micronization accomplished in a one-step process (higher purity)
6. Finished powder with exceptionally low moisture content (better preserved)

### 1. CELLULAR INTEGRITY:

VFD preserves the cellular, intracellular and molecular structure as closely as possible to the plant as it grows in nature. The factors that achieve this amazing result include:

- a. an evolutionary and transitional premium freeze dry process where the product is never **exposed to the destructive oxidative forces of heat. Here’s a trade secret regarding conventional freeze drying:** near the end of the process the moisture content may still be in the range of 10% plus. At this point the temperature is increased substantially to reduce this residual water content. This is not the case in Vortex Freeze-Dried Technology.
- b. In the case of dehydration or conventional freeze drying the dried product must be mechanically ground to achieve a fine powder. The reduction of particle diameter by mechanical processes such as crushing, cutting, milling or grinding hemorrhages the cellular structure and creates solid particles with flat surfaces and sharp corners. In VFD plant tissue fractures between/along the cell walls preserving cellular integrity and improving the retention of bioactive intracellular contents.
- c. Water removed as a liquid evaporates at a constant rate while the quantity of water steadily decreases. This creates surface tension. Any solid structure in contact with the water will experience surface tension strong enough to damage fragile cell walls. VFD, using sublimation, removes water in its gas state (water vapor) and avoids this destructive surface tension.

- d. **Exposure of the entire surface area to sublimation results in “even” drying which preserves cellular integrity.**

The extracellular matrix (ECM) consisting of molecules secreted by plant cells provides biochemical and structural support to surrounding cells. Plant ECM includes cellulose as well as signaling molecules that influence cell wall components. Dynamic biological functions of ECM include intercellular communications, growth factors, healing processes, gene expression, cell death (apoptosis), cell migration and differentiation as well as mechanical properties such as elasticity.

Damage, diminish or destroy intercellular and intracellular contents and you have dramatically limited the function and efficacy of your plant material regardless of to what degree you may capture specific targeted ingredients used as markers to indicate effectiveness. Maintain the complex synergy of the Master Formulator – Mother Nature.

## 2. BIOACTIVITY:

VFD preserves the cellular integrity and preserves the biochemical makeup of the plant material as described above and thus maintains the bioactivity of the plant material. In simplest terms VFD **products are “alive” rather than “dead.”**

## 3. BIO-AVAILABILITY:

In terms of nutritional science, bio-availability is a measure of the extent to which ingested substances are absorbed by our body and available for use or storage.

The value of our food, supplements, and medicine is part of a complex, vital, intelligent structure, and **it's the energetic breakdown and uptake of this structure that delivers the benefits.**

The true function and value of our foods comes as a result of their breakdown, release, absorption, and metabolism. A simple example of this would be tablets with super high synthetic vitamin C content. Your urine turns bright yellow/orange with a strong caustic odor. The vitamin C goes in one end and out the other. What good has that high vitamin C content provided you? Little to none.

The easier and more fully our food, supplements and medicine can be absorbed and metabolized, the greater their benefit will be to you. It is in this arena of bio-availability that the particle size and porous particle structure of VFD bio-active botanical powders makes them dramatically more effective. The physical principle is easy to understand. Smaller particle size and/or a porous particle structure provides more exposed surface area per unit of weight. The larger exposed surface area allows the powder to be absorbed more easily.

### a. MICRONIZATION:

The brittle super- frozen granules break naturally along cellular fracture-lines into very small particles due to the vigorous motion of the frozen particles combined with sublimation of the ice structure that holds the particles together. In this way VFD results in micronization

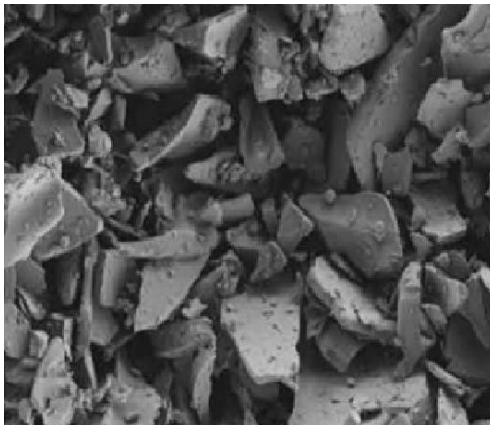


(dramatically smaller particle sizes) without hemorrhaging or demolishing the product by intense mechanical grinding.

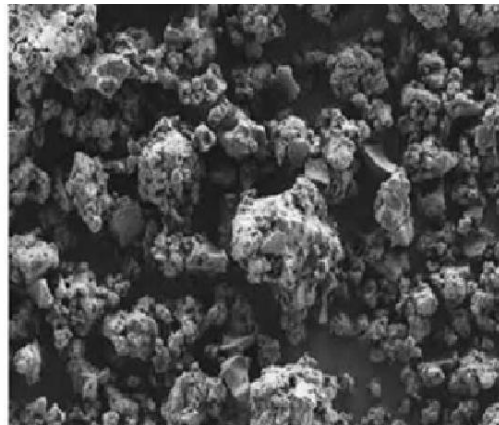
**b. POROUS PARTICLE STRUCTURE:**

In addition to reduced particle size, the structure of the particles have an impact on how easily they are absorbed and metabolized. CF L produces particles that are easily absorbed due to their porous structure. The physical principle is easy to understand. Porous particles provide more exposed surface area per unit of weight than solid particles. The larger exposed surface area allows the powder to be absorbed more easily.

The pictures below show clearly the difference in the particle structure produced by Vortex Freeze-Dried Technology, which results in higher bioactivity as well as higher bio-availability.



Conventional Freeze Dried Particles



VFD Particle Structure after mechanical grinding



Solid Particle Structure  
difficult to absorb or dissolve



Porous Particle Structure  
easily absorbed/ highly soluble


**Efficiency** -It is important to keep in mind that VFD not only produces a higher quality finished product, but does so with a level of efficiency and cost of production that conventional freeze drying can

not approach. In the conventional freeze dry process, the raw material is placed on trays which are placed on racks in the product chamber (see picture to the right).

The problem lies in the fact that only the exposed surface areas are dried by sublimation. If you pile the product on the trays, only the top and bottom (exposed surface areas) will dry. This means you can place only about  $\frac{3}{4}$  of one inch of product on the trays. The small quantity you place in the machine and the very small output of dry powder that results after the water has been removed makes this a slow, expensive process with very small yields.



This same principle applies to even the largest conventional freeze dry machines. The surface area of the trays occupied by the low specific weight of herbal raw materials (leaves, flowers etc) results in low output at high cost.

**In stark contrast, Thai Freeze Dry's** Vortex Freeze-Dried Technology , by dramatically increasing the exposed surface area, far exceeds conventional freeze drying in terms of drying time, low moisture content, quantity produced, production cost and quality.

## Vortex Freeze-Dried Technology







750 kg. Sprouted black rice powder in one 16 hour batch  
using TFD's Vortex Freeze-Dried Technology

The numerous larger VFD machines to be installed in the new TFD factory, now in the process of construction, will yield approximately 2,500 kg of finished sprouted black rice powder daily. Economy of scale results in substantially lower production costs.

VFD dramatically increases the exposed surface area during the drying process. This increases the rate of heat exchange which results in faster and more consistent drying of large quantities of raw material. A better heat transfer rate results from the continuous mixing of the product as it naturally breaks down into smaller particles during the drying process. Faster and more consistent drying of larger quantities results in both greater efficiency and increased quality:

- better conservation of the phytochemical constituents
- moisture content normally under 2% which indicates better preservation
- larger quantities over less time lowers costs making freeze drying a more commercially viable option

The VFD **machine produces only powder. It can't produce shape specific products such as dried chips.** It does not work well in the case of products with high levels of oil. The water is removed but the oil **remains and you don't get a fine dry powder. It does not** work well in the case of high sugar content. Freeze drying high levels of amorphous sugars results in hygroscopic powder highly susceptible to caking.

Vortex Freeze-Dried Technology is engineered to produce only dry powder, but it produces dry powder with a higher quality, more efficiently and more economically than any other process.

#### 5. ONE-STEP PROCESS = PURITY:

The entire process of drying and micronization takes place in one step and in one single unit. This is a "one port system." Raw product goes in and comes out as a finished powder. Eliminating multiple handling, multiple locations, and multiple processes decreases the risk of contamination, exposure to heat and exposure to moisture.

6. **POWER MOISTURE CONTENT=BETTER PRESERVATION:** Finished powder with lower moisture levels is better preserved. The idea behind drying is to eliminate the moisture which provides

the medium for microorganisms and enzymes to degrade the product. VFD, because it is faster, more consistent and exposes much more surface results in drier, better preserved powder.

## THAI FREEZE DRY FACTORY

