**Enzaq CoolFlashTM VAS3D Method Versus Freeze Drying**

Almost all companies in the Mussel Powder Industry use freeze drying methodology to dry their mussel meats. There are very few Mussel Powder producing companies (all in Europe using blue mussels) that use conventional spray drying methods to dry mussel meats in a conventional spray dryer. This is because high temperatures involved destroy nutritional properties and bioactivity of the end product. Only one company, Enzaq Aquaculture, uses a proprietary CoolFlash™ technology to reduce the damage to mussel powder inherent in both freeze drying and spray drying.

Enzaq Aquaculture mussel powder is produced through Enzaq’s method of CoolFlash™ VAS3D(Vacuum Assisted Suspended Spherical Surface Drying) which is faster and is done at much lower temperatures then either conventional spray drying or freeze drying. The temperatures of the product never exceed 37-42°C and are kept at that temperature for literally seconds. This compares very well with spray drying, which routinely operate at a temperature range of 45-50C and can reach higher temperatures with drying air temperatures being maintained at 150-175 C. ° C[[1]](#endnote-1). This alone makes conventional Spray Drying too “hot” for production of mussel powder.

Freeze drying process can be somewhat a misnomer as it has a very wide temperature range. Modern freeze dryers commonly operate between -35c to over +70 for extended periods of time. A leading New Zealand manufacturer of freeze dryers, Cuddon Ltd web site states “Cuddon General Purpose Lyophilizers range from 18kg to 1500kg condenser capacity, with shelf temperature ranges from **+70** to -35 deg C and ice condenser temperatures as low as -55 deg C.”[[2]](#endnote-2) Although the primary drying process is able to sublimate the ice crystals from the mussels while frozen, in order to remove the final intracellular moisture from the mussel, a secondary freeze drying process is utilized which increases the temperature in the freeze dryer to +70-80c for several hours at a time. It is worth noting that lipids (including vital Omega-3’s), proteins, amino sugars and many other nutrients are either destroyed or chemically altered at temperatures much above 42C.

In addition to the high processing temperatures of Freeze Drying this paper will look at the entire process step by step and show how it destroys bioactivity and allows excessive oxidation, lipid degradation, enzymatic destruction and requires the use of toxic stabilizers. It is our belief that addition of any chemical or additive in producing natural health products is to be avoided.

**The Birth of CoolFlash™ VAS3D**

Aquaculture Corporation was founded in 1967 and was a pioneer in the creation of the Greenshell Mussel industry. Aquaculture Corporation was the first company to make Greenshell Mussel powder. Dr Orville H. Miller, PhD in Pharmaceutical Chemistry at University of Southern California, established the Quality Assurance Procedures and Standards which were the foundation of the entire industry. Sadly, many of these Procedures and Standards are being neglected by today’s mussel powder producers. Originally, Aquaculture Corporation was using freeze drying to make its powder. However, with time Aquaculture founders had become concerned with the Freeze Drying process because of its variability in keeping high levels of bioactivity in mussel powder. While freeze drying at a small scale is an excellent way of creating a shelf stable powder, once production was ramped up to large volumes the process was not able to scale without significant modification. These modifications - such as intermediate cold storage, use of stabilizers and secondary heating processes - reduced mussel powder quality and made it highly variable. The founder of the company, Richard Dorst, decided that an entirely new solution to drying powder was necessary as far back as 1990. After several years of R&D Aquaculture Corporation developed the Enzaq® Process utilizing CoolFlashTM VAS3D technology and opened a production facility called Enzaq Aquaculture in Marlborough in 1995. It is the only company in the industry to use CoolFlashTM VAS3D. The defining characteristics of this process are fastest processing speed and low processing temperatures for highest quality and freshness. This is accomplished by combining the speed of Spray Drying with reduced temperatures and vacuum induction.

**CoolFlash™ VAS3D, a revolutionary proprietary process that has the following benefits and technologies:**

**-Shortest Processing Time –** Using CoolFlash™ VAS3D processing time is greatly reduced and the product goes from live mussel to vacuum packed powder in less than 30 minutes. This is by far the shortest processing time in the industry. No one even comes close.

**- Continuous Flow Versus Batch Process -** Freeze drying is a batch process; it can take days, weeks or even months to complete and requires 6 steps. Enzaq Process is a one step continuous flow process requiring no intermediate storage which leads to oxidation. The entire CoolFlash™ process takes less time than powder milling - the last step in the freeze drying process. Milling alone exposes the finished product to more heat, air contact and thus to oxygenation and moisture re-absorption than the entire Enzaq process.

- **Lowest processing temperatures in the industry.** Even though advertized as low heat, the freeze drying process is hotter than Enzaq’s CoolFlashTM VAS3D process.

- **Highest possible bio-available lipids** as tested by external testing laboratories. This is simply because our product is minimally processed thus retaining more of the lipids and Omega-3’s, the natural bioactivity of raw New Zealand Greenshell mussels. How can we claim this? It is very difficult to make such a claim consistently because mussels are a natural product and thus vary greatly from year to year, harvesting location, amount of available nutrients, etc. However, on average the mussels that have been processed quickly and at lower temperatures will show much higher bioactivity then mussels that have been damaged through heat and oxidation.

- **Lowest oxidation** damage to product: the contact with oxygen is limited due to short processing time.

- **Highest bioactivity** as tested by a third party laboratory.

- **No chemical stabilizers** need to be used because Enzaq’s process is so short the stabilization occurs naturally once moisture is removed, so you get the purest product on the market with **no toxic chemicals added**. –Tartaric Acid, a stabilizer used by one of our competitors, also known as dihydroxybutanedioic acid, is a known muscle poison which has been known to cause human death in high doses. Although the doses in their mussel powder and oil are quite low and are highly unlikely to cause harm, it is our belief that addition of any chemical or additive in producing natural health products is to be avoided.

- **Mussels are never frozen** in Enzaq’s process. In freeze drying, mussels are frozen twice and partially thawed out when transferred from a blast freezer (where they are stored awaiting the drying process) to a freeze dryer. Food safety guidelines strongly advise against eating a fish or meat product that has been re-frozen.

**ColdOpenTM Process:** a proprietary, semi-automatic process to remove mussel shells without heat which destroys bioactivity. Although this is the most time consuming and labor intensive part of the process it assures some of the lowest amounts of shell and mussel beards in the industry.

**A Typical Freeze Drying Process**

1. **Opening Process**

Hot Opening – Not used by most reputable companies, this involves cooking the mussels until they open. These are then shelled. Although easy and fast this process destroys bioactivity in the mussels before being turned to a powder rendering it as nothing more than protein powder.

Cold Opening – Using a more time consuming but less damaging, either high pressure opening methods or manual opening techniques the mussel is extracted from the shell without the use of heat. Some cold opening methods involve crushing the mussel in the shell and then centrifuging the mussel flesh out but this method leaves too much of the shell in the final product and should be avoided.

Enzaq Process uses manual, cold process which, although time consuming, reduces the shell content and process temperatures.

1. **Blast Freezing**

In the Freeze Dry process the shelled mussels are frozen direct or ground into coarse slurry. A chemical stabilizer is added to reduce enzymatic degradation caused by the gut enzyme. This slurry is then distributed in a thin layer on flat trays or the whole meats are frozen in bulk. Since this is batch process, the trays are frozen in a blast freezer to await the availability of Freeze Dryer.

1. **Storage**

Stabilization is required in this process because once the mussel is dead it immediately starts to deteriorate through enzymatic degradation. This process is not stopped by freezing of the meats or slurry. Since the freeze drying process takes place over a prolonged period of time, the damage to mussel meat can be significant. A chemical stabilizer is added in order to reduce oxidation and enzymatic degradation. It would not be necessary if the process didn’t take so long and expose the product to wide range of temperatures and oxygen. Enzaq process stops the enzymatic degradation by drying the product so quickly that the enzymatic activity is stopped.

In the blast freezer the product is exposed to both circulating air and to temperatures of -20 to -35c. Placing of open trays in a blast freezer causes significant oxidation and freezer burn. According to Avanti Polar Lipids handling guidelines “Storage of organic solutions below -30°C is not recommended unless the solution is packaged in a sealed glass ampoule.” But industry standard freeze drying processes can expose mussels to days and even weeks of freezing temperatures in open trays. Such long exposures to air and cold temperatures are highly damaging to lipids, and results in fewer being present in the finished product.

1. **Loading the Freeze Dryer**

Once the Freeze Dryer becomes available for loading the trays are manually removed from a freezer and loaded into the dryer. The temperature of the product is raised rapidly during the loading process. By the time the product is fully loaded the trays in the rear of the dryer can be either partially or fully thawed out.

1. **Freeze Drying Process**

Freeze Drying involves a primary and a secondary drying process. During the primary process the product is cooled to below -30c and air is removed creating a vacuum. Most of the moisture, especially ice crystals in the extracellular space is sublimated during this process. Intracellular moisture is more difficult to remove and would take days to do so without the application of heat. Since time is money the industry has come up with a way to speed up drying. For secondary drying process heating plates inside the dryer apply radiating heat to mussel meat to raise its temperature to 70c+ for several hours. Many of the nutrients spared during the application of stabilizer would now be destroyed through this heating process which is enough to pasteurize milk or juice. It is disingenuous for companies to claim that they eliminated hot opening techniques to reduce heat damage to mussel meat while at the same time heating them in the freeze dryer.

1. **Milling and Packing**

The Dryer is unloaded and the kibble is milled to make the kibble into a powder. During the milling process the powder is again exposed to heat, air and moisture. Moisture re-absorption leads to lipid degradation and bacterial growth. Milling creates a rough powder which requires the use of excipients during encapsulation and thus reduces the amount of mussel powder in each capsule. Enzaq Process creates a very fine powder without the need for milling. Enzaq powder is deposited directly from the dryer into the final packaging and vacuum sealed immediately. This allows a pure product without any additives to be encapsulated with the result that a “0” capsule of Enzaq powder contains 600mg of mussel powder versus industry standard of 500mg.

**Conclusion**

Enzaq Aquaculture CoolFlash™ VAS3D process is faster, cooler and purer then the freeze drying process used by most of the companies in the Mussel Powder industry. It is untouched by human hands at any stage from the live mussel to the finished vacuum packed final product. We believe that once customers understand the many undesirable properties of freeze dried mussels they will chose the Enzaq method as the one that will produce the best quality products with the best health effects for end users.

1. (http://class.fst.ohio-state.edu/Dairy\_Tech/14Spraydrying.htm) [↑](#endnote-ref-1)
2. Refer to Cuddon web site freeze dryer specifications page http://www.cuddonfreezedry.com/products/fd1500.html [↑](#endnote-ref-2)