VitaSphere™B12: Application and Formulation Guide

The incorporation of B12 into various formulations occurs in micrograms, and B12 is an unstable substance. It is susceptible to damage from heat, bright light and acidic conditions. This explains why the B12 content at the end of shelf life differs so much between formulations.

This guide focuses on seven types of formulations: tablets and multivitamins, capsules, gummies and chews, lozenges, drink mixes and powders, fortified cereals or foods, and premixes. For every type of formulation, we indicate where B12 is most likely to degrade, which of the B12 grades can work well, and how to confirm the result.

1. Why B12 is hard to keep stable

The first danger is heat. If cyanocobalamin is held at 100 °C for an hour, approximately 38% is lost. The second danger is acidity. Cyanocobalamin loses around 15% at pH 3, while methylcobalamin loses 79%.

The other ingredients are equally significant. Vitamin C can also degrade B12: methylcobalamin loses 70–76% in the presence of vitamin C. Thiamine, niacin, niacinamide and riboflavin can also cause losses, of 6–13% in one experiment. Light is yet another problem. All four forms of B12 are destroyed by UVA radiation.

Packaging also matters. Flour stored in multilayer bags showed no loss of B12 activity at all over six months, while in paper bags the loss was around 49–63%.

2. The VitaSphere™B12 grades

Code	Likely meaning	Typical use
TM	Dilution for very small doses	Low-dose blends, tablets, capsules
GR	Granulated	Tablets, capsules, flowable premixes
SR	Sustained-release (lab release profile only)	Tablets, capsules
IR	Immediate-release	Tablets, capsules, drink powders
LC	Lipid-coated (a fat-based protective layer)	Vitamin C premixes, heat or moisture exposure, gummies

3. Formulation by product type

Tablets and multivitamins

B12 faces many challenges during the tablet formulation process. In wet granulation, moisture is added and later removed by drying. Compressing the tablet has the potential to damage the protective layer. Moreover, B12 is in direct contact with vitamin C in the end product. We could not locate studies discussing solid B12 in commercial preparations. Nevertheless, surveys indicate that manufacturers tend to add an overage of the vitamin and thus provide more than what is stated on the label.

For trials, GR will provide better flow properties, whereas TM is more appropriate for very small doses. LC is used for vitamin C blends or for wet processes.

Capsules

Even though capsule filling is not too harsh, small amounts of B12 might still be lost in the process. Moisture can enter the capsule, and clear capsules allow light to penetrate. TM and IR grades can be used to fill capsules in their simplest form, MB/MP can produce a uniform particle size, and LC is used when vitamin C is to be incorporated in the fill.

Gummies and chewables

Of all available formats, gummies are the most challenging, since they are vulnerable to heat, acid and moisture. They are often known for their short shelf life. According to one patent, both vitamin C and folic acid were shown to decompose in gummy form, but there is no data on B12.

To minimize damage, start with an LC or other coated grade and add it at the latest point in the process that the temperature allows. Because its small particles dissolve the quickest when mixed with the rest of the components, TM gives the least protection to B12.

Lozenges

Compressed lozenges behave similarly to tablets. Cooked lozenges are different in that their melting point exceeds 100 °C, which is considered “hot” in this guide. No studies have been done on B12 lozenges, and we need information on how B12 behaves at melting temperatures before any claim can be made.

For compressed lozenges, the most suitable grades to test are GR or TM; for cooked lozenges, heat-stable LC or ME should be used at the lowest possible temperature.

Drink sticks and beverage powders

The dry powder is not at risk by itself. The issue arises as soon as it is mixed into a drink and exposed to its acidity, vitamin C and light. The powder also requires complete dissolution.

One should look into IR or fine TM, which dissolve very rapidly. LC can also be considered if dry-storage protection is more important than avoiding residue. If the label allows the drink to be kept after mixing, B12 should still be tested in the liquid.

Fortified cereals and foods

Extrusion is a process that employs high temperature, pressure and moisture, while baking applies even more heat in an oven. Applying B12 after cooking is one solution that avoids heat, but it may expose the vitamin to air and light.

Trials on animal feed have shown that low-temperature extrusion retains more of the B vitamins than high-temperature processes, and that encapsulated vitamins are preserved better than non-encapsulated ones, but the abstract does not mention B12. The packaging used had a significant effect in the flour study.

Premixes

In a premix, vitamin B12 remains in contact with vitamin C and other B vitamins for a protracted period. LC is common when vitamin C is plentiful, while TM or MB/MP serves the purpose of homogeneous mixing with limited amounts of the vitamin. It is also wise to agree early on who will bear which loss: the premix maker (during storage) or the recipient (during its process).

4. Testing methods

B12 content can be analyzed by HPLC, or by immunoaffinity cleanup of the sample followed by HPLC analysis. The method should be validated for each product. After the content is analyzed, uniformity tests and sampling are conducted to check that B12 is distributed uniformly in the batch. For tablets or capsules, disintegration and dissolution tests give an idea of how the product behaves upon dissolution.

Laser diffraction or sieving, and bulk and tapped density measurements, are used to characterize particle size and flow properties. The Carr index is calculated as $100 \times (\text{tapped} - \text{bulk}) \div \text{tapped}$, and the Hausner ratio as $\text{tapped} \div \text{bulk}$. A large difference between tapped and bulk densities indicates poor flow.