

Vitamins

Vitamin B-complex



YMC

Vitamins are organic molecules involved in numerous functions within the human body, acting for example as precursors of coenzymes, meaning substances that assist enzymes in performing specific functions in the organism. Their roles also include, but are not limited to, participation in metabolic processes such as energy production and the prevention or treatment of certain diseases.

Within the context of B-complex vitamins, vitamin B1 (thiamine) is used in the production of thiamine pyrophosphate (TPP), which in turn plays an important role in key biological pathways, such as aerobic glucose metabolism, contributing to energy generation in the human body. In severe deficiency cases, vitamin B1 may also be used therapeutically for the treatment of conditions such as beriberi or Wernicke–Korsakoff syndrome.

Likewise, vitamin B6 leads to the production of pyridoxal-5-phosphate (PLP), which participates in a variety of important biochemical reactions associated with immune system function, brain health, and the metabolism of carbohydrates, proteins, and fats.

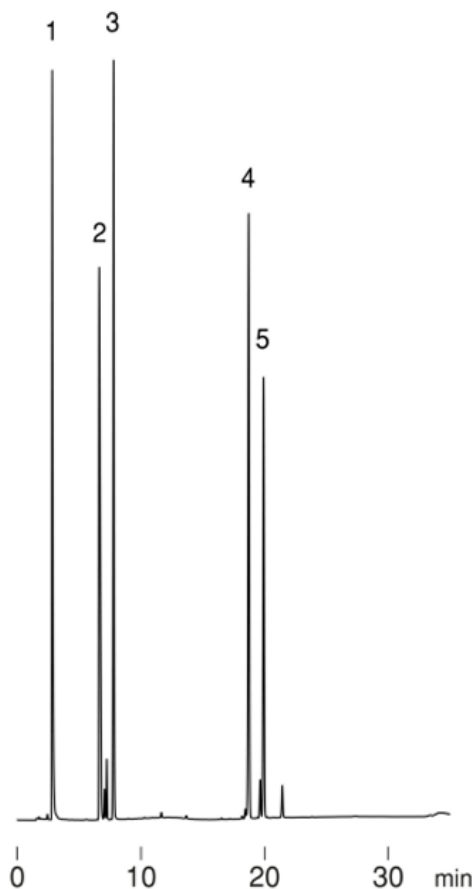
Beyond supplements and pharmaceutical products, vitamins also have applications in cosmetic formulations, including hair products and skin creams. Their functions may include hair strengthening, skin conditioning, treatment of conditions such as dermatitis and seborrheic disorders, and many other benefits.

Although vitamins are extremely important for the human body, most cannot be synthesized endogenously, creating the need for daily intake through a balanced diet capable of meeting recommended levels. Vitamin capsule formulations serve as dietary supplements intended to complement nutritional intake and ensure adequate daily consumption of these substances. In many cases, these products are also developed with a nutraceutical purpose, naturally supporting the prevention of potential health conditions through mechanisms that are similar to those previously discussed.



YMC offers several solutions primarily based on C18 columns. The Hydrosphere C18 is a chromatographic column packed with highly purified inorganic silica functionalized with C18 groups and endcapping groups, resulting in a relatively low hydrophobic surface. This model is particularly attractive for applications employing 100% aqueous mobile phases, as illustrated in Figure 1.

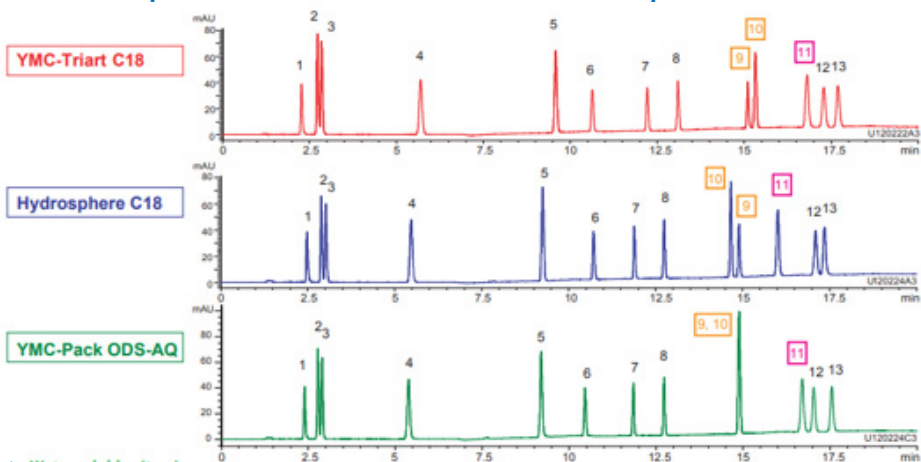
Figure 1



Column: Hydrosphere C18 (5 μm , 12 nm), 150 x 4.6 mm ID
Eluent: A) 50 mM $\text{KH}_2\text{PO}_4\text{-H}_3\text{PO}_4$ (pH 3.5)
B) 50 mM $\text{KH}_2\text{PO}_4\text{-H}_3\text{PO}_4$ (pH 3.5)/acetonitrile (80/20)
0-90 % B (0-20 min), 90 % B (20-30 min)
Flow rate: 1.0 mL/min
Temperature: 30 $^\circ\text{C}$
Detection: UV at 254 nm, 0.32 AUFS
Injection: 15 μL (0.04 ~ 0.60 mg/mL)

For more complex multivitamin panels, the recommended approach generally requires a more robust solution through the use of Triart stationary phases. The Triart C18 maintains compatibility with 100 % aqueous mobile phases while providing several additional advantages, including a hybrid silica matrix that offers chemical, thermal, and mechanical resistance (particularly beneficial for more acidic mobile phases); particle synthesis using microreactor technology, ensuring excellent morphological characteristics and very high performance; multi-step endcapping procedures combined with strict material purity control to minimize unwanted secondary intermolecular interactions; and trifunctional bonding chemistry that provides alternative selectivity.

Comparison of three YMC phases that can be used with 100 % aqueous



Water soluble vitamins

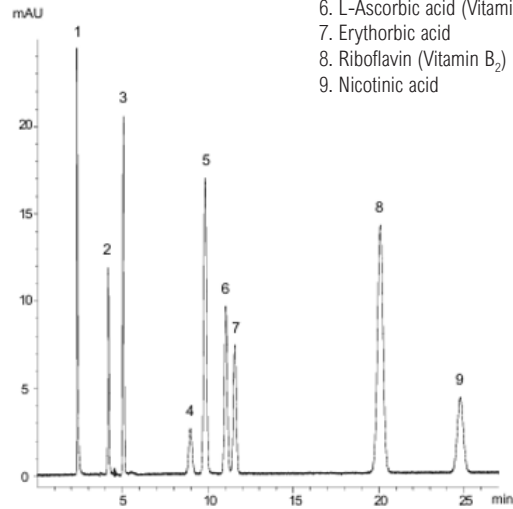
1. L-Ascorbic acid 2-glucoside
2. L-Ascorbic acid
3. D-Isoascorbic acid
4. Nicotinamide
6. D-(+)-Pantothenic acid calcium salt
7. Pyridoxal hydrochloride
8. Pyridoxine hydrochloride
9. Folic acid
10. Thiamine hydrochloride
11. Cyanocobalamin
12. D-Biotin
13. Riboflavin

Column:	3 μ m, 150 x 3.0 mm ID
Eluent:	A) 20 mM KH_2PO_4 - H_3PO_4 (pH 2.8) containing 5 mM $\text{CH}_3(\text{CH}_2)_5\text{SO}_3\text{Na}$ B) 20 mM KH_2PO_4 - H_3PO_4 (pH 2.8)/acetonitrile (80/20) containing 5 mM $\text{CH}_3(\text{CH}_2)_5\text{SO}_3\text{Na}$ 0%B (0-3 min), 0-75 %B (3-13 min), 75 %B (13-20 min)
Flow rate:	0.425 mL/min
Temperature:	40 $^\circ\text{C}$
Detection:	210 nm

Retention behavior of water soluble vitamins on three YMC ODS phases that can be used with 100 % aqueous mobile phase is compared. Retention time and elution order of Folic acid (peak 9), Thiamine hydrochloride (peak 10), and Cyanocobalamin (peak 11) are different among three phases. This is because the balance of hydrophobicity and hydrogen bonding capacity differs from column to column.

Still focusing on alternative selectivities, it is also possible to modify the ion-pairing reagent employed (whether surfactant- or chaotropic-based) in order to achieve a chromatographic profile that may better satisfy a specific separation requirement. In this case, YMC also provides an example method using a tetrabutylammonium cation-based ion-pairing reagent instead of sodium hexanesulfonate.

1. Thiamine HCl (Vitamin B₁)
2. Pyridoxine HCl (Vitamin B₆)
3. Nicotinamide
4. Cyanocobalamin (Vitamin B₁₂)
5. L-Ascorbic acid 2-glucoside
6. L-Ascorbic acid (Vitamin C)
7. Erythorbic acid
8. Riboflavin (Vitamin B₂)
9. Nicotinic acid



Column:	YMC-Triart C18 (5 μ m, 12 nm)
Eluent:	Phosphate buffer*/acetonitrile (90/10) *Dissolve 1.4 g KH ₂ PO ₄ in 800 mL water \rightarrow and 26 mL 10 % TBA•OH \rightarrow adjust pH 5.2 by 20 % H ₃ PO ₄ \rightarrow add water to make 1000 mL
Flow rate:	0.425 mL/min
Temperature:	40 °C
Detection:	210 nm

References:

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