Beverage Fortification
Introduction

Apart from fulfilling an indispensable human need, beverages also form a part of the culture of human society. Juices, energy drinks, bottled mineral water, UHT milk, soy milk, drinking yoghurt, and smoothies - just to name a few - are familiar for their inherently healthy image to varying degrees. However, consumer demands have changed with time; consumers now look for health benefits from their beverages, not just good flavours. Thus, in order to improve the energy-nutrient ratio and meet health-conscious consumers’ demands, the fortification of beverages plays an important role. In a recent survey in the United States, more than half of the respondents reported consuming micronutrient-fortified fruit juices or drinks several times a week.

Consumer demands are at a peak, and so are the manufacturers’ prospects for developing novel and healthy beverage products.

Why should you consider Beverage Fortification?

Most foods are excellent sources of several micronutrients. However, inappropriate food choices lead to unbalanced diets which are unlikely to provide adequate levels of all micronutrients. There are a variety of reasons and goals for beverage fortification. Consumers have a keen eye for beverages that offer health benefits over their natural nutritional content, as beverages are accepted delivery vehicles for providing nutrients. Fortified beverages have varied importance for diverse audiences. For some, a diet fortified with essential nutrients is indisputably necessary for a healthy life; for others, the quality of basic amenities such as tap water may be the reason why they choose a safer, and thus healthier, bottled alternative.

A wide variety of beverages are suitable for fortification, including fruit juices, fruit nectars, vegetable juices, enhanced water, aerated drinks, energy drinks and sports drinks. In addition, developing countries can also be targeted with multinutrient-fortified beverages to reduce the incidence of micronutrient deficiencies. In regards to micronutrient malnourishment, fortified beverages have the ability to address more than one micronutrient insufficiency simultaneously, as well as the ability to provide the nutrients in isolation from meals containing inhibitors of mineral absorption such as phytate - not to mention the likelihood of higher adherence due to the pleasant fruity flavour of the beverage. The growth in the beverage market is driven by the health options required by the consumer. Hexagon Nutrition assists manufacturers to meet their customers’ demands with a range of beverage fortificants that deliver desirable health benefits.
Beverages are often fortified with multiple minerals and vitamins in order to have a greater nutritional impact, as opposed to fortification with a single micronutrient. Nutrients for beverage fortification may be selected from vitamins, minerals, trace elements, amino acids, etc. The quantity of the nutrients to be added to the fortified food corresponds to an amount generally recognised as both safe and effective by the Food & Drug Administration or the Recommended Daily Allowances (RDA). For those supplements for which no RDA has been officially formulated, an amount generally accepted as both safe and efficacious may be utilised.

On a weight basis, as a percentage of the total dry beverage formulation, these additional nutrients can make up from about 0 to 20%, more particularly in the range of about 0.01 to 5%. The choice of nutrients used to fortify beverages is based on a number of factors such as the chemical form of the micronutrient in terms of its bioavailability, the effects on the organoleptic characteristics of the particular beverage and cost. The composition of the micronutrient premix and the initial calculation of the micronutrients are based on a number of considerations:

- The food vector, the fortification micronutrients and their levels must be chosen as a function of the nutritional requirements and deficiencies, as well as of the dietary habits, of the target population or consumer group.
- The nature of the beverage vector will have considerable bearing on the fortification due to organoleptic alterations that may be caused by the addition of certain micronutrients.
- The stability of vitamins is affected by a number of factors such as temperature, moisture, oxygen, light, pH, minerals (especially iron and copper), vitamin-vitamin interactions, other food components, processing methods and storage.
- To maintain the micronutrient levels declared on the product label throughout a product's shelf life, the amount of vitamins added during processing needs to be higher than the levels reported on the label.
- Interactions between minerals can also have implications for mineral bioavailability in fortified products with multiple minerals.
What kind of technology is involved with Beverage Fortification?

To suit consumers’ needs of refreshment and health in the suitable and convenient vector of beverages, formulation trends are showing major changes. While pre-planning for the beverage fortificants, the solubility, bioavailability, pH, temperature, light and stability of individual ingredients, overall stability, colour and flavour of the finished beverage should be considered. Ingredient interactions are common, so one way to minimise interactions is to separate vitamins and minerals into two individual premixes. Another approach is encapsulating certain vitamins or minerals. The primary objective of encapsulation is to extend the shelf life and quality of the product by separating the fortificants from the vehicle’s components and environment until release is desired.

Encapsulation is used to mask undesirable flavours and to isolate reactive components to prevent the degradation of micronutrients. The method for beverage fortification includes creating a blend or composition of the nutrients. The resultant blend or composition is added to a beverage to form a fortified beverage, or the blend or composition is mixed with the beverage to form a homogeneous fortified beverage. The mixing is done in vertical tanks filled with turbine or propeller agitators. The effectiveness of the mixing depends upon a number of factors such as viscosity, flowing characteristics and mixability of the components, as well as proportions of the components being mixed. For micronutrients such as vitamin A, vitamin C and B vitamins, which are subject to oxidative degradation, antioxidants are added to the premix.

As a beverage becomes fortified, the pH of the beverage rises and therefore the beverage becomes more basic. To counter this, an acidulent is typically added to the beverage in order to keep the pH of the beverage lower. The acidulent is added in order to bring the pH of the beverage down and counter the effects of fortification. As the beverage is more acidic, it becomes more resistant to microbial growth.

In order to ensure that the mineral-trace element premix is added to a processed food at the correct level, iron is often used as a tracer. Several methods can be used for iron determination: X-ray fluorescence spectroscopy, atomic absorption spectroscopy, inductively coupled plasma emission spectrometry and calorimetric methods. Similarly, the addition of vitamins to foods in a multivitamin premix may be controlled by determination of vitamin C as the tracer in the food. Methods commonly used include high-performance liquid chromatography, titrimetry using a visual or calorimetric end point, or rapid calorimetry.
Do the micronutrients remain stable?

In most cases, the pH of fruit drinks and juices is below 4.5 and the heat treatment required is pasteurisation. Some loss of heat labile vitamins, thiamin, folic acid and ascorbic acids occurs as a result of the thermal treatment. The acidity of these drinks causes problems of stability with vitamin A, folic acid and calcium pantothenate. Carbonation of these beverages, with the resultant exclusion of oxygen, improves the stability of vitamins. The presence of sulphur dioxide in the fruit juices used in the production of these beverages has been shown to have a detrimental effect on thiamine content.

Precautions included the use of stainless equipment, addition of vitamins at the latest possible stage, avoidance of excessive aeration or even de-aeration, rapid cooling after thermal treatment and the avoidance of readily auto-oxidisable ingredients. Riboflavin and thiamin showed good stability but vitamin C showed about a 23% loss. Beta-carotene and apocarotene both showed good stability in fortified drinks, but the latter was less stable on exposure to sunlight.

Vitamin stability is affected most by heat, moisture, pH and light; but, given their chemical heterogeneity, vitamin losses in different foods vary considerably during both processing and storage of the final product. The most unstable vitamins are C, A, D, B1 and B12. The effectiveness of a powdered breakfast drink fortified with iron, vitamin A and vitamin C was found to be very good. For organoleptic considerations, ferrous gluconate was found to be superior to ferrous sulphate. The fortification of beverages with calcium has become a popular practice. Insoluble Ca and Mg salts cause lightening of food colour, whereas soluble salts may interact with other food components, such as tannins, to cause darkening. Minerals have also been reported to interact with anthocyanins containing vicinal hydroxyl groups, causing a red-to-blue colour change.

Milk beverages are usually fortified with Vitamin D and Vitamin A, although a few other micronutrients have ample scope for its incorporation. Because of its greater biological efficiency, vitamin D3 is the form generally used in milk products. Vitamin D3 is very stable in homogenised whole milk and is not affected by pasteurisation or other processing procedures. In contrast, vitamin A in fluid skim or low-fat milk can be destroyed rapidly when milk is exposed to sunlight in translucent plastic containers or transparent glass bottles. High-calcium soy milk can be prepared by adding calcium gluconate as a calcium source with satisfactory heat stability of the final beverage. Many of today's yoghurt products use calcium carbonate as their source of calcium due to its economy of use, high bioavailability, and high elemental calcium level, which means a lower weight is needed to give the desired level of fortification.
Hexagon Nutrition aims to satisfy the manufacturers' need to develop beverages that target specific markets and consumer groups. We customise premixes as per the specifications provided by our clients, to ensure the provision of health benefits and sensory appeal using a combination of the following ingredients:

- Vitamin A - Vitamin A Acetate/Vitamin A Palmitate
- Vitamin B1 - Thiamine Mononitrate
- Vitamin B2 - Riboflavin
- Vitamin B3 - Niacinamide
- Vitamin B6 - Pyridoxine HCl
- Vitamin B9 - Folic Acid
- Vitamin B5 - Calcium D Pantothenate
- Vitamin B12 - Cyanocobalamin
- Vitamin C - Ascorbic Acid
- Vitamin D - Cholecalciferol / Ergocalciferol
- Iodine - Potassium Iodide/Potassium Iodate
- Selenium - Sodium Selenite
- Zinc - Zinc Sulfate / Zinc Gluconate
- Magnesium - Magnesium Sulphate / Magnesium Gluconate / Magnesium Citrate
- Manganese - Manganese Sulphate
- Calcium - Micronized Tricalcium Phosphate / Calcium Gluconate / Calcium Citrate / Calcium Lactate / Calcium Glycerophosphate
- Phosphorus - Micronized Tricalcium Phosphate/Mono Potassium Phosphate
- Iron - Ferrous Gluconate / Sodium Iron EDTA / Ferric Pyrophosphate
References
