



Renewable and Bio-Based Products for Food Ingredients, Flavours and Nutrition

Renewable Products and Bio-Based Esters

Green Biologics is a producer of 100 % renewable n-butanol which we aim to transform into higher value flavour and fragrance additives for the food industry. We recognize that a number of butyl esters that are currently being formulated into many food recipes are partially bio-based as they employ carboxylic acids that are or can be derived from natural oils. As such, we desire to partner with these producers to utilize our renewable n-butanol to provide renewable butyl esters and work with others seeking to add bio-based products and processes to their repertoire.

n-Butanol – GB nC4-OL™ is the brand name for our renewable n-butanol. It is a four carbon primary alcohol utilised as a flavour and fragrance additive and intermediate for the food industry. GB nC4-OL™ is marketed as EU and US Natural. Its non-toxic nature, and its mixture of polar and nonpolar functionalities make GB nC4-OL™ an excellent extraction solvent for processing egg yolks and making hop extract for beers. n-Butanol occurs naturally as a part of carbohydrate fermentation and is present in a number of alcoholic beverages such as beer, whiskey, and wine as well as certain types of cheese and other fermented products.



100 % Renewable Flavour Esters



Butyl Acetate – An ester of butanol and acetic acid. As acetic acid is the primary component of vinegars, this ester could be available as a 100% renewable ester by utilising existing technology or

vinegar production. Butyl acetate is a naturally occurring substance that is commonly used in banana, butter, pineapple, raspberry, and strawberry flavoured or scented products.

Butyl Butyrate – Another naturally occurring ester, butyl butyrate is found in apples, bananas, berries, pears, and strawberries and is an excellent additive for flavouring candies, ices, and beverages.

Butyl Caprylate – Caprylic acid and its esters are found in mammalian milk and in the oils of coconuts and palm kernels. When esterified to n-butanol, the resulting ester is capable of adding apple, banana, pear, plum, or strawberry flavours and fragrances when mixed in the appropriate formulation.

Butyl Cinnamate – This compound is the ester of butanol and cinnamic acid, which can be isolated from ground cinnamon. This ester can be part of the formulations of chocolate, cocoa, or fruity flavours used in baked goods, beverages, candies, ice creams, and ices.



Butyl Hexanoate – Formed from the esterification of n-butanol and hexanoic acid, this ester is known for its fruity smell resembling ripe berries. Hexanoic acid is a common fatty acid that is found in sources as diverse as animal fats, milks, oils, as well as vanilla. Use of this ester adds butter, butterscotch, pineapple, or rum flavours to baked goods, beverages, candies, ice creams and ices.

Butyl Isobutyrate – Isobutyric acid, in addition to being found in nature, can be produced through sugar fermentation. Esterification of these isobutyric acid and n-butanol together yields a natural and renewable banana, butter, cherry, raspberry, or strawberry flavour additive.

Butyl Isovalerate – Isovaleric acid occurs naturally during many types of fermentations and during bacterial metabolism of the amino acid leucine. Whilst the parent acid has a decidedly unpleasant smell, the butyl ester is renowned for its sweet apple-like taste and herbaceous, fruity odour. This compound can also be used as a chocolate flavour additive in the appropriate formulation.

Butyl Lactate – Butyl lactate is a multifunctional ester more commonly seen in cosmetics and various industrial applications. Lactic acid is a well-known carboxylic acid that occurs naturally in the human body and is capable of being produced through industrial fermentation. When butyl lactate is applied as a food flavouring additive it can impart butter, butterscotch, caramel, or fruity flavours.

Butyl Laurate – Lauric acid is a long-chain saturated fatty acid that makes up approximately half of the acid components in coconut and palm kernel oils, making it readily available for esterification with n-butanol. This ester is known for adding exotic flavours such as Cape gooseberry, malt whiskey, papaya, and spineless monkey orange to foods and beverages.



Butyl Levulinate – Levulinic acid is a simple derivative of common table sugar. Whilst butyl levulinate is utilised in a number of unique industrial applications, it can be produced from natural components and imbibes several valuable and diverse flavours including savory (bacon, butter, chocolate, and herb) and sweet fruits (banana, cherry, honeydew, and melon).

Butyl Stearate – A multifunctional ester produced utilising stearic acid, butyl stearate can be renewably sourced as it is one of the most common fatty acids in nature with both animal and vegetable sources known. Butyl stearate can be used as a banana, butter, or liquor flavouring or antifoaming additive in the food industry.

Butyl Undecanoate – An ester of n-butanol and the long-chain fatty acid undecanoic acid, this compound adds rich apple cider, cognac, and sweet buttery nut flavours such as almond, maple, and pecan to baked goods, beverages, candies, chewing gum, ice creams, ices, and liqueurs.