

Jungbunzlauer Tricalcium Citrate (TCC):

TCC in toothpaste

Toothpaste formulations have to meet a range of consumer's expectations, such as pleasant appearance and taste and efficient cleansing. Optical appeal and benefit on oral health therefore plays a major role in the selection of toothpaste ingredients. Using TCC as a bulk agent in toothpaste can fulfil multiple purposes, including mechanical abrasion of dental plaque, remineralisation and opacification. TCC is produced by complete neutralisation of citric acid with a high purity calcium source such as calcium hydroxide or calcium carbonate. With its high calcium content of 21%, TCC is the most economic calcium salt among the commonly used organic calcium salts.

TCC as an abrasive agent

Calcium-based abrasives for mechanical cleansing have a long history of use in toothpaste. Typical calcium-based agents comprise calcium carbonate and or calcium phosphate, which are used as bulk abrasives in amounts of up to 50%. Prerequisites are insolubility, suitable particle size and material hardness, allowing for efficient removal of plaque without posing a risk to dentin and enamel integrity. TCC from Jungbunzlauer is available in a range of particle sizes and is hardly soluble in water (< 1g/L). Therefore, it is a suitable bulk abrasive agent in toothpaste. Determining the RDA (relative dentin abrasion) value by radioactive labelling according to DIN EN ISO 11609, it was shown that TCC is very gentle to tooth dentin, with the finest granulation (type M1098) having an RDA value of 12 and the slightly coarser granulation (M7090) having an RDA value of 15. In a stain removal test on bovine teeth, TCC showed a good cleaning capacity comparable to dental silica and calcium phosphate. Therefore, TCC can be applied as a gentle abrasive agent in toothpaste.

TCC as an opacifier

An intensely white appearance of toothpaste is a desirable feature increasing consumer appeal. Titanium dioxide (TiO₂) is the state of the art whitening pigment for toothpaste and many other cosmetic products due to its unique refractive index. In toothpaste, it is commonly used in amounts of 0.5%. However, more and more manufacturers are looking for alternative opacifiers. Due to its material properties and fine micronisation, Jungbunzlauer's TCC M1098 has a very bright, intense white appearance and can therefore be used as an opacifier, also in toothpaste. To investigate this, different amounts of TCC in a xanthan gum slurry were compared with a 0.5% TiO₂ slurry as a reference regarding their whiteness. For this, the colour coordinates L*a*b* were measured by a colorimeter, in which the whiteness is given as a value of L ("luminescence"). It was found that 5% TCC resulted in a similar whiteness as 0.5% TiO₂ ($\Delta L = 1.5$). Therefore, TCC offers the additional function of opacification when used as an abrasive agent in toothpaste but may also be used as only for the purpose of opacification in combination with standard abrasives.

TCC for remineralisation

Calcium is an essential component of the tooth substance hydroxyapatite. This substance is prone to demineralisation when the pH in the oral cavity drops due to unfavourable microbial metabolic activity. In this process, calcium and phosphate ions dissolve from hydroxyapatite, resulting in lesions and ultimately caries. pH buffering by salivary flow and the presence of calcium, fluoride and phosphate ions in the saliva counteract this deleterious process by promoting remineralisation of hydroxyapatite. In this process, TCC acts as source of calcium ions with a better bioavailability than other calcium-based abrasives with lower solubility.

Summary

TCC has multiple benefits as a toothpaste ingredient, acting as a gentle abrasive agent, opacifier and source of calcium ions for remineralisation. Jungbunzlauer provides TCC of different particle sizes to choose from depending on the desired functionality.