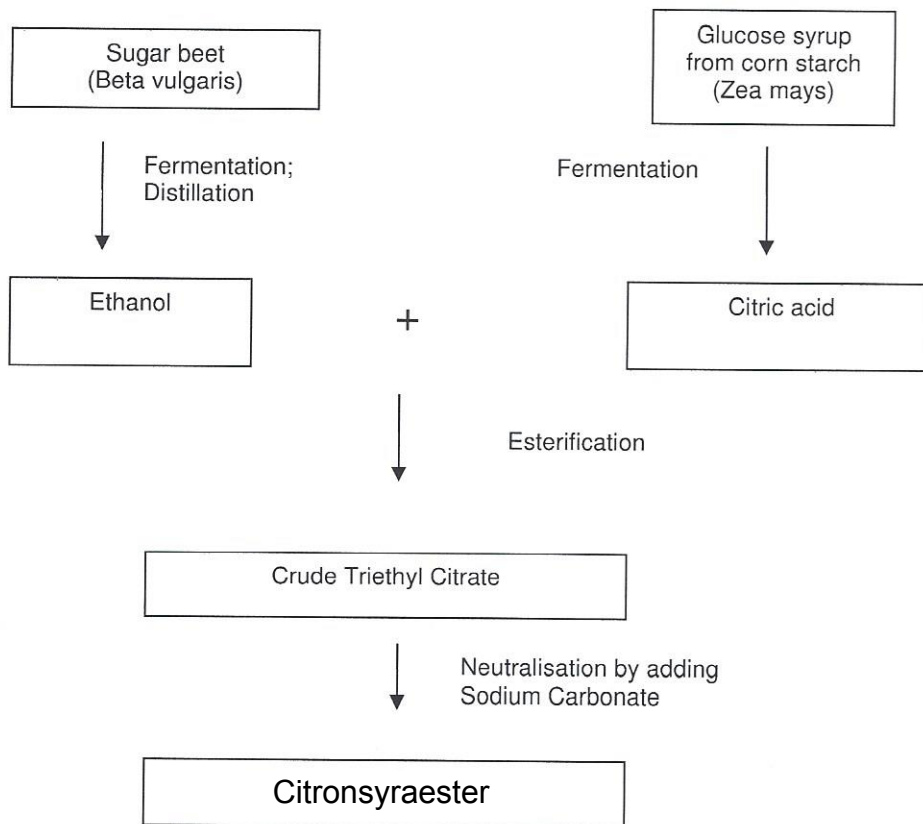


COSMETIC RAW MATERIAL PRODUCT Manufacturing Certificate

We hereby certify that our product **4051 Citronsyraester** is not of animal origin. It is obtained by esterification of citric acid with (bio)-ethanol. For further details please refer to the subsequent process chart.

Process chart for the manufacturing of **citronsyraester** (INCI: Triethyl Citrate)



TRIETHYL CITRATE IN DEODORANTS

Triethyl citrate has a long history of use in deodorants, due to its ability to inhibit the esterase activity of bacteria and its well-known properties as a solvent and fixative for fragrances and perfumes.

Responsible for malodour are short chain fatty acids from sweat, which are liberated by the action of bacterial esterases on the skin. Triethyl citrate does compete with these sweat target molecules and if present in a sufficiently high concentration gets metabolized instead of the odour-liberating compounds on our skin. When hydrolyzed by esterases, Triethyl citrate resolves into ethanol and citric acid. Citric acid lowers the pH at the esterase site and thereby inhibits the pH-dependent enzyme activity. This mechanism of action is depicted in Figure 1.

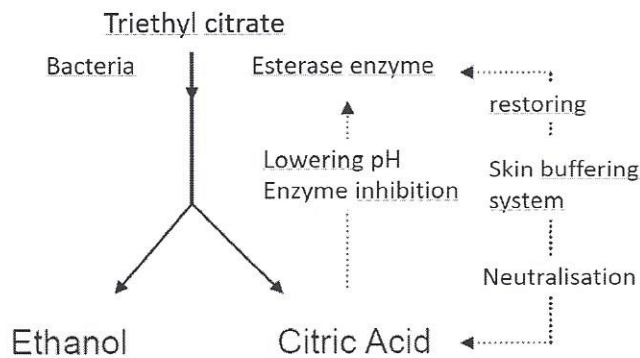


Figure 1

An US patent (US 2008/0287377 A1) demonstrated the concentration-dependent esterase inhibition activity of Triethyl citrate in a colorimetric assay. In this test they determined the esterase activity by measuring the amount of free fatty acids. A reduction of free fatty acids indicates a reduction in esterase activity (Figure 2).

	Absorbance		fatty acids reduction compared to control (%)	
	Mean			
	15'	30'	15'	30'
Control	0.7125	0.095	—	—
TEC 0.5%	0.584	0.084	18.04	11.10
TEC 1%	0.5905	0.083	17.12	12.70
TEC 5%	0.393	0.018	44.84	81.50

Figure 2

Another patent (WO 2000037035 A1) demonstrated a synergistic esterase inhibition effect of Triethyl citrate together with Glycerine carbonate (Figure 3).

Komponenten	R1	R2	R3	R4	R5	R6	R7	R8
Glycerincarbonat	3,0	2,0	1,0	0,5	2,0	2,0	-	-
Trialkylcitrat	-	-	-	-	5	5	-	5
Aluminiumchlorhydrat		-	-	-	-	20	20	20
Ethanol	20	20	20	20	20	20	20	20
Wasser	ad 100							
Esterase- Restaktivität [%]	79	74	79	83	52	55	100	80

Figure 3: As can be seen, glycerine carbonate inhibits the activity of the esterase (R1 to R4). In combination with a known esterase inhibitor Trialkylcitrat (Triethyl citrate) there is a synergistic inhibition of esterase (R5). (Esterase-Restaktivität = esterase activity)