



Nitrosamines

EMA/369136/2020; FDA Guidance for Industry „Control of Nitrosamine Impurities in Human Drugs“

MEGGLE Products:

- Lactose Monohydrate: FlowLac® 90, FlowLac® 90 MS, FlowLac® 100, FlowLac® 100 MS, FlowLac® 100 SD

The formation of potent genotoxic nitrosamines as impurities is possible in the presence of secondary, tertiary, or quaternary amines and nitrite salts under acidic reaction conditions.

Regarding the requests of EMA-CHMP and FDA-CDER that marketing authorisation holders for human medicines containing chemically synthesised active substances have to evaluate the risk for the possible presence of nitrosamines (e.g. NDMA, NDEA, NMBA, NMPA, NIPEA, NDIPA), a risk evaluation was conducted for the MEGGLE Products used as excipients to support the marketing authorisation holders. This evaluation is based on the [IPEC Questionnaire](#) and attached.

The risk evaluation reflects the whole manufacturing process at MEGGLE starting with whey independent from the defined starting material as regard of GMP requirements.

The MEGGLE Products are isolated and purified from whey which is a by-product of cheese manufacturing. Therefore, nitrite traces might come from the raw material whey and water. Testing on nitrates and nitrites is conducted as part of incoming goods inspection of whey. The acceptance limits are as follows: Nitrate < 50 ppm, Nitrite < 5 ppm.

The process water is regularly tested on nitrites. Results are given in the risk evaluation.

The MEGGLE Products are natural materials and are not chemically synthesised. The chemical structure does not contain nitrogen. Organic solvents, catalysts and other reagents which might be a reason for the presence of secondary, tertiary or quaternary amines and nitrite salts are not used. The manufacturing includes several washing steps as well as double crystallisation and refining. These steps are leading to a highly purified product. The manufacturing process does not create the highly acidic conditions necessary for the formation of nitrosamines and for drying only indirect heating is used. There is no potential NO_x generation from combustion.

The MEGGLE Products are tested on nitrites using bracketing principles. Furthermore, test results on nitrosamines are available. Results are given in the risk evaluation.

Conclusion: Neither the chemical composition nor the processing conditions indicate any possibility for nitrosamine contamination and formation in the process or storage of MEGGLE Products.

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Nitrosamine Risk Evaluation

1) Applicable category based on structure and origin of the excipient in support to evaluate the risk of formation of nitrosamines in the excipient¹

Target Excipient: Nitrogen containing?	Yes	<input type="checkbox"/> Proteins, enzymes, products of fermentation or extraction of biologic sources, ...	<input type="checkbox"/> Synthetic origin and nitrogen containing
	No	<input checked="" type="checkbox"/> Mined excipients, N-free products of fermentation or natural origin, ...	<input type="checkbox"/> N-free mineral acids or bases, organic solvents, polymers, inorganic salts, small organic N-free entities, ...
<div style="display: flex; justify-content: space-around; margin-bottom: 10px;"> No Yes </div> <div style="border: 1px solid black; padding: 5px; text-align: center;"> Chemical Synthetic Manufacturing Process? including processes to introduce chemically synthesized fragments to biological products or substances of natural origin </div>			

2) Is sodium nitrite (NaNO ₂) or any other nitrite or nitrosating agent ² :	YES	NO	<i>Information not available</i>
- used in any steps in the manufacturing process as reagents/catalyst?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
- known to be used in the preparation of raw materials or intermediates used in the manufacturing process?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
- known to be used in the preparation of reagents/catalysts/processing aids used in the manufacturing process?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
- known or likely to be generated as impurities during the manufacturing process?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
- deliberately added to the process, including components of cell culture media or for fermentation?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3) Have you analysed the excipient for:	YES	NO	<i>Test result</i>
- nitrites?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<i>≤ 0.10 ppm</i>
- nitrosamines?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<i>< 0.1 ppb</i>
Nitrites: Method IC with LoD 0.01 ppm, LoQ 0.03 ppm. Result is regarded as "typical". Nitrosamines, i.e. NDMA, NDEA, NDPA, NDBA, NMOR, NPYR, NPIP, NMEA, NDIPA: Method GC/TEA with LoD 0.1 ppb, LoQ 0.5 ppb. Result is regarded as "typical". Tests are conducted in a contracted laboratory.			
4) Is water used in the manufacturing process? If "Yes":	YES	NO	<i>Not applicable</i>
i. is purified water ³ used in the manufacturing process?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ii. if potable water is used, where possible, please report the maximum level of nitrite.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maximum levels of			<i>Not available</i>
- Nitrites			<input type="checkbox"/>
LoD 0.02 mg/l. Legal requirements according Directive (EU) 2020/2184: Nitrites < 0.5 mg/l	< LoD		
5) Are there any secondary and/or tertiary amines ⁴ present in the manufacturing process as:	YES	NO	
- raw material ⁵ ?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- intermediate?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- reagent?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- processing aids?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- catalyst?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- solvent?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
If yes, are those amines present in the ...			<i>Not applicable</i>
- same	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
- previous	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
- subsequent	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

step as any nitrosating agent mentioned in section 2?

¹ Nitrogen-free materials are considered to be of lower inherent risk for nitrosamine contamination as they are typically manufactured and do not contain nitrosatable structures. Nitrosamines have been observed in medicinal products with N-containing APIs of chemical synthetic origin. EMA concludes that there is a very low risk of nitrosamines being present as impurities in biological medicinal products, although it can't be completely ruled out.

² See Guidance 1 in Annex

³ Prepared by distillation, ion exchange, reverse osmosis

⁴ See Guidance 2 in Annex

⁵ 2020 IPEC General Glossary of Terms and Acronyms, <https://www.ipec-europe.org/glossary.html>

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Nitrosamine Risk Evaluation

6) Is there any amide, primary amine or ammonium salt used or present in the substance manufacturing process as:	YES	NO	
- Raw material?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- Intermediate?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- Reagent?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- Processing aids?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- Catalyst?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- Solvent?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
- Washing Fluid?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
7) Recycled/recovered Solvents ⁶ :	YES	NO	
- Are recycled / recovered nitrogen containing solvents used in the manufacturing process?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
8) Equipment:	YES	NO	<i>Not applicable</i>
- Is the substance produced in multipurpose equipment?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
- In case of multipurpose equipment, is the equipment used for manufacturing of any material involving nitrites, nitrosating agents or material with identified risk of formation of nitrosamines?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
- Are chloramines used as part of cleaning procedures used for manufacturing equipment?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
9) Additional comments, if any, not covered in the questionnaire			

Annex⁷:

Guidance 1 (Sources of nitrosating agents)

Nitrosating agents to be considered include: nitrites (e.g. sodium nitrite, NaNO₂) and nitrous acid (HNO₂), nitric oxide (NO), nitrosyl halides (e.g. ClNO, BrNO), dinitrogen trioxide (N₂O₃), dinitrogen tetroxide (N₂O₄) and organic nitrites (e.g. t-BuONO).

Other potential nitrosation risks:

- Side reaction in nitration reactions. Nitric acid typically contains nitric oxide as an impurity, additional nitrous acid may also be produced, leading to nitrosation, if any reducing agents are present.
- Hydroxylamine under oxidative conditions.
- Chloramines are known to generate N-nitrosamines under certain conditions and so should also be considered.⁸
- Ozone may lead to the formation of N-nitrosamines by initial oxidation of amines to nitrite.
- Use of azide salts and azide compounds is commonly followed by quenching with nitrous acid or nitrites and may lead to nitrite residues.
- Nitric acid and nitrates under reducing conditions may result in by-products with nitrosating activity.

This evaluation must include the use of all chemicals within a process, including those used during the quench and work-up as well as during reactive chemistry.

Guidance 2 (Sources of secondary and tertiary amines)⁹

Secondary amines are of greatest concern, however tertiary amines can also undergo nitrosation via more complex pathways. All secondary and tertiary aliphatic and aromatic amines should therefore be considered including those present as part of the starting material, intermediate or final structure as well as those introduced as reagents, catalysts, solvents or as impurities.

Tertiary amine bases (i.e. triethylamine, diisopropylethylamine and N-methylmorpholine) are known to degrade to secondary amines and have been implicated in N-nitrosamine formation.

Amines may also be introduced as impurities or degradants:

- Of common amide containing solvents such as N,N-dimethylformamide (DMF), N,N-dimethylacetamide (DMAC) and N-methylpyrrolidinone (NMP)
- Of quaternary ammonium salts such as tetrabutylammonium bromide (TBAB)
- Of primary amines such as monoethylamine
- Of starting materials, intermediates or the product itself

This evaluation must include the use of all chemicals within a process, including those used during the quench and work-up as well as during reactive chemistry.

Guidance 3 (Potential contamination risks)

Consider all potential sources of contamination in input materials.

Use of recovered materials (solvents, reagents, catalysts) is of particular concern if appropriate controls are not put in place. The materials DMF, ortho-xylene and tributyltin chloride were highlighted by the EMA as materials at risk of cross contamination by N-nitrosamines. Sodium azide was highlighted by Health Canada for risk of cross contamination with nitrite.

Cross contamination from other processes using shared equipment should be considered. Steps performed under GMP (using solvents/reagents with appropriate controls, and controls on their recovery and reuse) are considered to be a lower cross contamination risk.

⁶ See Guidance 3 in Annex

⁷ This information is partly transferred from the EFPIA decision tree for drug substances, published 1 Nov 2019

⁸ Nawrocki, J et al. Nitrosamines and Water, J. Hazard. Mater. 2011, 189, 1-18.

⁹ SCCS (Scientific Committee on Consumer Safety), Opinion on Nitrosamines and Secondary Amines in Cosmetic Products, 27 March 2012.

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