EUMETABOL®
THE EFFECTIVE ORIGINAL.

Eumetabol® glutathione infusion therapy

Information for healthcare professionals:

- Proven dosages
- Usage and product information
- Key findings of the study

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Contents

High intracellular glutathione levels play a central role in a wide range of healthy physiological processes.[3; 4]

Glutathione:

A labile substance of the utmost physiological importance

“What we are witnessing is a profound paradigm shift: glutathione is no longer merely an antioxidant and a detoxifying compound, but a redox-active compound that plays a key role in numerous and highly diverse biological processes.”[1]

Glutathione, a tripeptide produced naturally by the body, is involved in countless physiological processes. In recent years – not least as a result of the COVID-19 pandemic – crucial new insights have been gained into the molecular basis of its diverse functions. As our understanding of the subject grows, glutathione therapy is becoming increasingly important in the treatment of a wider range of conditions.

Most of glutathione’s physiological properties are linked to the thiol (SH) group in its cysteine moiety.[2] This SH group is highly reactive and therefore unstable. For this reason, it is virtually impossible to administer reduced glutathione exogenously in such a way that it is bioavailable and therefore effective within the body.

Nevertheless, effective glutathione therapy is possible. According to numerous studies, the most effective and sustainable option for this is a specific pharmacological formulation: the acetylation of reduced glutathione (GSH) to S-acetyl-glutathione (SAG, Eumetabol®). This use of an acetyl protecting group was developed and patented by the biochemist and physician PD Dr. med. habil. Gerhard Ohlenschläger in order to make GSH suitable for medical use.

Eumetabol® can be used to raise intracellular glutathione levels to such an extent that GSH can perform its full range of functions (see chart on the left).

S-acetyl-glutathione: A key strategy for increasing intracellular glutathione levels

“Oral administration of GSH does not […] result in a significant increase in GSH levels […]. S-acetyl-glutathione […] is more stable in plasma, is taken up by cells and is subsequently converted into GSH.”[5]

Due to its immense physiological importance, glutathione also has a wide range of medical applications: glutathione therapy is beneficial for all conditions associated with a deficiency of the body's own glutathione. This spectrum ranges from complementary cancer therapies and liver diseases to chronic fatigue and anti-ageing (see section "Indications and areas of application").

In recent years, scientific attention has also turned to the importance of glutathione metabolism in relation to COVID-19 and other viral diseases[3; 6–47] – and, with it, the links between viral infections, glutathione and the development of, for example, myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS), multi-organ diseases or tumours.

This brochure summarises key research findings on glutathione therapy in this context. A key focus of medical and biological research is the problem that **exogenous administration of reduced glutathione**, as it occurs naturally in the body, **does not increase the body's own glutathione levels**.

By contrast, many scientists regard the glutathione derivative **S-acetyl-glutathione (Eumetabol®)** as the **best way to increase intracellular glutathione levels**.[5; 48–55] This approach can have a positive impact on viral diseases such as SARS-CoV-2 and their associated complications, such as post-COVID, as well as many other conditions. S-acetyl-glutathione hascome to the attention of the scientific community not least because it has been used successfully for many decades to treat other fatigue-related conditions, such as

- tumour fatigue,
- myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS),
- post-viral fatigue,
- burnout,
- exhaustion resulting from prolonged physical, mental and emotional strain.

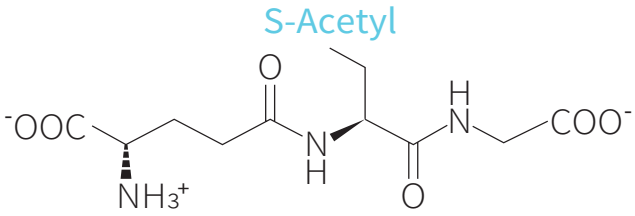
From its direct antiviral effects to the maintenance of key immune functions, from combating cell-damaging free radicals to restoring and maintaining a healthy energy balance – there is growing evidence that the glutathione system is a key target. You can read up on the latest research in this brochure.

How the active pharmaceutical ingredient S-acetyl-glutathione (Eumetabol®) works and its benefits

“In recent years, S-acetyl-glutathione (SAG) […] has demonstrated high bioavailability in preclinical and clinical trials.”
This glutathione derivative has been shown to significantly increase the intracellular concentration of the tripeptide.”[53]

S-Acetyl-glutathione (SAG): able to cross cell membranes and protected from oxidation

S-acetyl-glutathione (SAG) is the acetylated derivative of reduced glutathione (GSH) at the thiol group: in SAG, the hydrogen atom of the thiol (SH) group of GSH, which is highly susceptible to dimerisation and other reactions, is replaced by an acetyl group (shown in blue in the molecular structure).



This acetylation makes the active ingredient **in Eumetabol® particularly bioavailable**[55], as

- it is thus **protected from oxidation** and,
- in its acetylated form, can pass through the cell membrane **unharmed via the ABCC1/MRP transporter**[56].

Both mechanisms ensure that the S-acetyl-glutathione in Eumetabol® **is delivered directly into the cell** – the actual site of action. Intracellularly, SAG is then hydrolysed to GSH by the enzyme thioesterase **in an optimal ratio of 1:1**.[57]

The longer half-life of Eumetabol® resulting from acetylation, combined with its improved uptake into cells and its conversion to GSH in a 1:1 ratio, explains its excellent bioavailability.

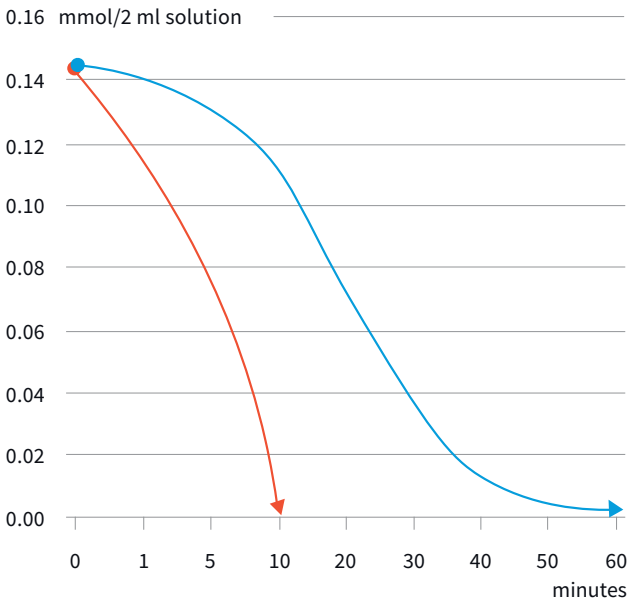
Reduced glutathione (GSH): rapidly oxidised, not membrane-permeable

By way of comparison: the SH group in **GSH** is highly susceptible to oxidation. As a result, GSH has an extremely short half-life, which is only 1.6 minutes even when administered intravenously.[5; 48; 53] When taken orally, GSH oxidises even more rapidly and thus becomes **ineffective**. Furthermore, GSH itself does **not cross cell membranes**.[5; 48; 52–54; 57–60]

Due to its different properties, the bioavailability of reduced glutathione is too low to affect intracellular glutathione levels.[54]

Whilst reduced glutathione is broken down by proteases within approximately 10 minutes[54] and is therefore no longer detectable in the blood, SAG (Eumetabol®), with its acetyl protective group, has a significantly longer half-life. The resulting bioavailability ensures a sustained therapeutic effect.

Comparison of the half-life of S-acetyl glutathione and reduced glutathione in human blood



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Cysteine, glycine, glutamic acid and the like: of no therapeutic value

The body's own synthesis of GSH in the cytoplasm from its three **amino acids** (glutamic acid, cysteine, glycine) – a process that a healthy organism is capable of to at least some extent – is not a viable therapeutic option, as this **synthetic process is often disrupted** in the context of viral infections and many other diseases.[58]

The administration of individual GSH building blocks or their derivatives – e.g. in the form of N-acetylcysteine – is not suitable for therapeutic use, as endogenous synthesis of intracellular GSH from exogenously supplied individual amino acids does not occur.[47; 58]

Comparison

Eumetabol® ⟷ Amino acids ⟷ GSH

EUMETABOL® (S-ACETYL-GLUTATHIONE)	INDIVIDUAL COMPONENTS: GLUTAMIC ACID, CYSTEINE, GLYCINE	RED. GLUTATHIONE
High stability due to acetylation	The synthesis of GSH from individual amino acids within the cell is not guaranteed	High reactivity due to a lack of acetylation; prone to dimerisation and other non-specific reactions
Accelerated passage of the intact molecule through the cell membrane and conversion of SAG to GSH within the cell (1:1)	Premature utilisation of individual amino acids via other metabolic pathways **→ no resynthesis to GSH**	Not able to cross the cell membrane; the molecule is broken down into individual amino acids before passing through the cell membrane **→ no resynthesis to GSH**
Long half-life[54] **→ optimal bioavailability**	N/A	Half-life of just 1.6 minutes **→ not sufficiently bioavailable**[48; 54]
The gold standard in glutathione therapy, as it acts specifically within the cells	**Therapeutically pointless**	**Not suitable for therapeutic use, as it has no intracellular effect**

Conclusion on SAG (Eumetabol®): excellent bioavailability, combines very well with other supplements

SAG in Eumetabol® is a novel agent with powerful antioxidant and antiviral properties. In addition to its general antiviral and immunomodulatory properties, Eumetabol® can also be effectively combined with antiretroviral agents, amongst other things (see dosage recommendations).[57]

SAG (Eumetabol®) stands out as the only active ingredient when compared with other glutathione therapies:

- **Pure GSH taken orally does not raise GSH levels.**
- **Even when administered intravenously, the half-life of GSH is so short that no effects, or only very minor effects, are observed.**
- **The same applies to conventional GSH derivatives and GSH precursors.**

- **In preclinical and clinical studies, only the GSH derivative SAG in Eumetabol® was found to be optimally bioavailable and therefore therapeutically beneficial.**[5; 47; 48; 53; 59]

Information for healthcare professionals

Eumetabol® in clinical practice

Eumetabol® glutathione infusions enable the administration of high doses of the active pharmaceutical ingredient S-acetyl-glutathione, manufactured to GMP standards, in a simple and, for patients, very comfortable manner. These infusions can effectively and sustainably increase intracellular levels of reduced glutathione. The indications and areas of application, as well as the precise method of use, are described on the following pages.

Indications and areas of application for the active pharmaceutical ingredient S-acetyl-glutathione (Eumetabol®)

The indications and areas of application for S-acetyl-glutathione (Eumetabol®) stem from the vitally important physiological functions performed by this tripeptide: glutathione is found in almost all cells of the body, as well as outside the cells, including in blood plasma, tissues and bodily fluids. Mitochondria, the "powerhouses" of the cells, contain 10-15 per cent of the cell's glutathione. Glutathione performs vital functions within the body. It is therefore regarded as the most important antioxidant, as it provides effective protection against oxidative and nitrosative stress. It is essential for regulating key cellular processes (e.g. DNA repair). Within the mitochondria, it ensures the supply of energy in the form of adenosine triphosphate (ATP). Furthermore, due to its high binding capacity, glutathione helps to detoxify a wide variety of harmful substances – whether these are recreational toxins, food additives, environmental toxins or harmful metabolites of medicines. Last but not least, glutathione plays a vital role in maintaining a healthy immune system. The reasonbeing that it plays a role in the production of leukotrienes and prostaglandins and stimulates lymphocyte activity.

A wide range of applications in prevention and treatment

Eumetabol® glutathione infusions are beneficial for all symptoms associated with glutathione deficiency and increased oxidative stress (see next page).

Proven areas of application include, amongst others

- Chronic fatigue syndrome (ME/CFS) and its subtypes,
- Detoxification therapies (e.g. chelation therapies),
- Mitochondrial disorders (e.g. metabolic syndrome),
- Chronic inflammation (oxidative and nitrosative stress),
- Infections, including candidiasis,
- Arthritis,
- Cardiovascular diseases,
- "Better ageing" (disease prevention, maintaining quality of life and vitality).

Key applications of S-acetyl-glutathione (Eumetabol®) are also based on the fact that it helps maintain healthy mitochondrial function and reduces oxidative stress. Glutathione therapy may therefore also be beneficial in cases of allergies and intolerances, fibromyalgia, cataracts, obesity, degenerative neurological disorders (Parkinson's disease, Alzheimer's disease, etc.) or fertility problems. Furthermore, it is generally beneficial for health maintenance and prevention (see next page).

Glutathione deficiency

Conditions with a proven link to glutathione deficiency

Brain and nervous system

- Alzheimer's disease
- Parkinson's disease
- Chorea Huntington
- Amyotrophic lateral sclerosis (ALS)
- Migraine
- Multiple sclerosis
- Autism
- Attention-deficit/ hyperactivity disorder (ADHD)
- Bipolar disorder
- Depression

Cardiovascular

- Atherosclerosis
- Angina pectoris
- Erectile dysfunction
- High blood pressure
- Stroke

Immune system

- AIDS
- Lupus erythematosus
- Viral diseases
- Bronchial asthma
- Acne
- Lyme disease
- Allergies
- Gingivitis (inflammation of the gums)
- Rheumatoid arthritis

Thyroid and pancreas

- Diabetes mellitus
- Pancreatitis
- Hyperthyroidism
- Hypothyroidism

Tumour-related conditions (concomitant)

- Breast cancer
- Lung cancer
- Cervical cancer
- Bowel cancer
- Ovarian cancer
- Leukaemia

Energy balance

- Myalgic encephalomyelitis / chronic fatigue syndrome (ME/CFS)
- Long COVID / post-COVID
- Tumour fatigue
- Burnout

Others

- Inflammatory skin conditions
- Premature ageing
- Arthritis
- Chronic obstructive pulmonary disease (COPD)
- Gout
- Hepatitis (all forms)
- Cystic fibrosis
- Infertility
- Deteriorating eyesight (including macular degeneration)
- Stomach ulcers


konzentrat Eumetabol® Fatigue
100 ml Infusionskonzentrat zur i.v. Infusion
vor Licht geschützt bei 2 – 8°C
Viktoria Apotheke Saarbrücken
apothekenpflichtig
konzentrat Eumetabol® Detox
100 ml Infusionskonzentrat zur i.v. Infusion
vor Licht geschützt bei 2 – 8°C
Viktoria Apotheke Saarbrücken
apothekenpflichtig
konzentrat Eumetabol® Immun
100 ml Infusionskonzentrat zur i.v. Infusion
vor Licht geschützt bei 2 – 8°C
Viktoria Apotheke Saarbrücken
apothekenpflichtig
konzentrat Eumetabol® 3.000
20 ml Infusionskonzentrat
zur i.v. Infusion nach Verdünnung
vor Licht geschützt bei 2 – 8°C
Viktoria Apotheke Saarbrücken
apothekenpflichtig

Eumetabol® infusion concentrates

Eumetabol® is based on the **individual dosing** of the active pharmaceutical ingredient S-acetyl-glutathione. In this way, the dose can be adjusted to ensure that the treatment is as effective as possible.

The cornerstone of the treatment is the Eumetabol® infusion SAG mono 3,000 mg.

Eumetabol® infusion SAG mono 3,000 mg

To optimise intracellular glutathione levels

Applications of mono infusions:

- All conditions and symptoms associated with an intracellular glutathione deficiency (as described in this leaflet)
- Anti-ageing and preventive healthcare

Components:

S-acetyl-glutathione 3,000 mg, TRIS, 0.9% NaCl

Contents: 20 ml

Core therapeutic pillar

Eumetabol® infusion SAG mono 3,000 mg

The cornerstone of any treatment and prevention for glutathione deficiency

Eumetabol® infusion sets: innovative combinations for your practice

In addition to the Eumetabol® mono infusion concentrates, which form the cornerstone of glutathione therapy, the specially developed Fatigue, Detox and Immun infusion sets exist for specific purposes. They combine the active pharmaceutical ingredient S-acetyl-glutathione (Eumetabol®) with an orthomolecular blend specifically tailored to particular areas of application.

Eumetabol® Fatigue – infusion set

To reduce fatigue

The formulation, containing vitamins and amino acids, has been optimised to provide patients suffering from exhaustion with essential micronutrients during the acute phase. Thanks to the vitamin C it contains, the infusion also helps to strengthen the immune system in the long term.

Applications of the set:

- Acute and chronic fatigue conditions, e.g. chronic fatigue syndrome (ME/CFS) and its subtypes (burnout), post-viral fatigue, long COVID
- Cancer-related fatigue
- Recovery from illness
- Increased pressure and stress in everyday life
- Menopausal symptoms
- Sleep disorders, lack of sleep, jet lag
- Provides support during periods of high mental and physical strain, as well as during shift work

Eumetabol® Fatigue infusion
Contents: 100 ml

Components:

Sodium L-ascorbate 5,000 mg, L-lysine HCl, L-methionine 1,000 mg each, L-phenylalanine 600 mg, L-glutamine 500 mg, L-threonine, nicotinamide 300 mg each, D-panthenol 180 mg, riboflavin-5-phosphate monosodium salt, thiamine HCl 100 mg each, pyridoxine HCl 40 mg, adenosylcobalamin, methylcobalamin 1 mg each, water

Eumetabol® infusion SAG mono 3,000 mg
Contents: 20 ml

Components:

S-acetyl-glutathione 3,000 mg, TRIS, 0.9% NaCl

Eumetabol® Detox – infusion set

For supporting the body's natural detoxification processes

The formula significantly enhances the body's detoxification processes whilst strengthening the organs responsible for detoxification. The infusion provides the nutrients needed for optimal liver function. Thanks to the vitamin C it contains, the infusion also supports the body's natural detoxification processes and helps to strengthen the immune system.

Applications of the set:

- Inadequate detoxification
- An unhealthy lifestyle (smoking, an unbalanced or poor diet, etc.)
- Daily contact with solvents, paints, varnishes, chemicals and other hazardous substances
- Poor skin condition and/or hair loss
- Taking a lot of medication
- Drug intolerances (as an indication of reduced liver detoxification capacity)
- Reduced performance
- Frequent headaches/difficulty concentrating
- Infertility
- As a preventive measure as we get older

Eumetabol® Detox infusion
Contents: 100 ml

Components:

L-ascorbic acid sodium salt 12,000 mg, L-ornithine-L-aspartate 2,400 mg, L-threonine 1,500 mg, L-lysine HCl, L-methionine 1,000 mg each, nicotinamide 300 mg, D-panthenol, pyridoxine HCl, riboflavin-5-phosphate monosodium salt, thiamine HCl 100 mg each, folic acid 6 mg, adenosylcobalamin, methylcobalamin 1 mg each, water

Eumetabol® infusion SAG mono 3,000 mg
Contents: 20 ml

Components:

S-acetyl-glutathione 3,000 mg, TRIS, 0.9% NaCl

Eumetabol® Immun – infusion set

For regulating immune function

This combination supports and regulates the body's own immune system by strengthening and regenerating the key immune mechanisms both inside and outside the cells. The key components of the Eumetabol® Immun infusion set are S-acetylglutathione, vitamin C, L-arginine and nicotinamide.

Applications of the set:

- Immune deficiency
- Delayed recovery, including following viral infections (e.g. long COVID)
- Feeling down and lacking motivation
- Increased stress, high mental and/or intense physical strain
- Lack of exercise
- Poor nutrition (micronutrient deficiency)
- As a preventative measure during the cold season

Eumetabol® Immun infusion
Contents: 100 ml

Components:

L-ascorbic acid sodium salt 12,000 mg, taurine 1,200 mg, L-arginine 1,000 mg, L-carnosine, L-histidine, L-methionine 700 mg each, L-phenylalanine 600 mg, L-threonine 500 mg, nicotinamide 300 mg, pyridoxine HCl, riboflavin-5-phosphate monosodium salt, thiamine HCl 100 mg each, D-panthenol 80 mg, folic acid 3 mg, adenosylcobalamin, methylcobalamin 1 mg each, water

Eumetabol® infusion SAG mono 3,000 mg
Contents: 20 ml

Components:

S-acetyl-glutathione 3,000 mg, TRIS, 0.9% NaCl

The following information applies to all Eumetabol® infusion concentrates and infusion sets:

Dosage form:

Concentrate for intravenous infusion following dilution

Stock information:

Store away from light at 2-8 °C

Shelf life:

6 months from the date of manufacture

Recommended doses by indication / health status

Core therapeutic pillar:
Eumetabol® infusion SAG mono 3,000 mg – the cornerstone of any treatment and prevention for glutathione deficiency

1. Prevention

Eumetabol® infusion SAG mono 3,000 mg

Therapeutic priority		Dosage: **6,000 mg of Eumetabol®** (S-acetyl-glutathione) per week
Optimal application period		Once a week for **5-10 weeks** (can also be done several times a year)
2 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml)	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**

Eumetabol® Fatigue – infusion set
When under stress

1 ×	Eumetabol® Fatigue infusion (100 ml)	in **500 ml** NaCl 0.9% **over 45-60 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml), **included with the infusion set**	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml) **additionally**	

Eumetabol® Detox – infusion set
To support the body's natural detoxification processes

1 ×	Eumetabol® Detox infusion (100 ml)	in **500 ml** NaCl 0.9% **over 45-60 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml), **included with the infusion set**	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml) **additionally**	

Eumetabol® Immun – infusion set
To regulate immune function

1 ×	Eumetabol® Immun infusion (100 ml)	in **500 ml** NaCl 0.9% **over 45-60 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml), **included with the infusion set**	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml) **additionally**	

2. Acute illness

Therapeutic priority	Dosage: **12,000 mg of Eumetabol®** (S-acetyl-glutathione) per week
Optimal application period	Over a period of **4-8 weeks** (2–3 times a week)

Day 1

2 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml)	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**

Day 2

2 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml)	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**

Eumetabol® Fatigue – infusion set

In cases of severe exhaustion

e.g. chronic fatigue syndrome (ME/CFS) and its subtypes (burnout), post-viral fatigue, long COVID, cancer-related fatigue

Day 1

1 ×	Eumetabol® Fatigue infusion (100 ml)	in **500 ml** NaCl 0.9% **over 45-60 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml), **included with the infusion set**	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml) **additionally**	

Day 2

2 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml)	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**

Eumetabol® Detox – infusion set

In cases of significantly impaired detoxification capacity

Day 1

1 ×	Eumetabol® Detox infusion (100 ml)	in **500 ml** NaCl 0.9% **over 45-60 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml), **included with the infusion set**	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml) **additionally**	

Day 2

2 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml)	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**

Eumetabol® Immun – infusion set

For immune modulation and the stabilisation of immune functions

Day 1

1 ×	Eumetabol® Immun infusion (100 ml)	in **500 ml** NaCl 0.9% **over 45-60 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml), **included with the infusion set**	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**
1 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml) **additionally**	

Day 2

2 ×	Eumetabol® infusion SAG mono 3,000 mg (20 ml)	6,000 mg in **250 ml** NaCl 0.9% **over 20-30 minutes**

3. Maintaining glutathione levels

A maintenance dose is recommended following treatment.

Recommended dosage	**3,000-6,000 mg of Eumetabol®** (S-acetylglutathione) per week, as required

General instructions for the use of Eumetabol® infusion concentrates and infusion sets

General instructions for the use of Eumetabol® infusion concentrates and infusion sets

Do not administer the Eumetabol® glutathione infusion on an empty stomach to prevent possible hypoglycaemia.

Do not administer the Eumetabol® glutathione infusion on an empty stomach to prevent possible hypoglycaemia.

If a detoxification disorder is present, the administration of Eumetabol® infusion concentrates may cause malaise, headaches and detoxification symptoms, as the body's detoxification function is stimulated.

Patient information leaflet

Eumetabol® infusion SAG mono 3,000 mg

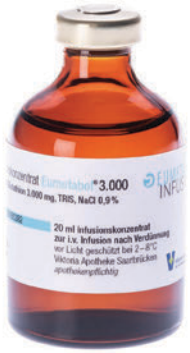
Application:

Dilution
in ≥ 100 ml NaCl 0.9%

- **Dissolve the entire contents of the concentrate in at least 100 ml of 0.9% saline solution.**

Duration of infusion
15-20 minutes

- **The infusion takes 15-20 minutes.**



Additional dosage information for Eumetabol® infusion SAG mono 3,000 mg
A single dose of **up to 6,000 mg/day** (in 250 ml of 0.9% NaCl over 20-30 minutes) is possible.
However, the dose of 6,000 mg per day should not be exceeded.

The use of Eumetabol® (S-acetyl-glutathione) infusion concentrates is not indicated in the following cases:
decompensated liver cirrhosis, known hypersensitivity to any of the ingredients, during pregnancy or while breastfeeding, and 24 hours before or 72 hours after chemotherapy*.

**Please note regarding chemotherapy and radiotherapy: When using Eumetabol® mono infusions and Eumetabol® infusion sets for the supportive/preventative treatment of cancer- and chemotherapy-related fatigue, care must be taken to ensure that there is a sufficient time interval between administration and chemotherapy or radiotherapy, so that the high antioxidant capacity of Eumetabol® does not reduce the effectiveness of the chemotherapy or radiotherapy.*

Eumetabol® infusion sets (Fatigue, Detox, Immun)



Administration: Administer infusions separately, one after the other!

Initial use: Eumetabol® infusion sets (Fatigue, Detox, Immune)

Dilution
in ≥ 500 ml NaCl 0.9%

- **Dissolve the entire contents of the concentrate in at least 500 ml of 0.9% saline solution.**

Duration of infusion
45-60 minutes

- **The infusion takes 45-60 minutes.**

Second use: Eumetabol® infusion SAG mono 3,000 mg

Dilution
in ≥ 100 ml NaCl 0.9%

- **Dissolve the entire contents of the concentrate in at least 100 ml of 0.9% saline solution.**

Duration of infusion
15-20 minutes

- **The infusion takes 15-20 minutes.**

Additional dosage information for Eumetabol® infusion SAG mono 3,000 mg
A single dose of **up to 6,000 mg/day** (in 250 ml of 0.9% NaCl over 20-30 minutes) is possible. However, the dose of 6,000 mg per day should not be exceeded.

The use of Eumetabol® infusion sets (Fatigue, Detox, Immun) is not indicated in the following cases:
G6PD deficiency, a tendency to develop kidney stones, heart failure, decompensated liver cirrhosis, metabolic acidosis, known hypersensitivity to any of the ingredients, during pregnancy or while breastfeeding, and 24 hours before or 72 hours after chemotherapy*.

**Please note regarding chemotherapy and radiotherapy: When using Eumetabol® mono infusions and Eumetabol® infusion sets for the supportive/preventative treatment of cancer- and chemotherapy-related fatigue, care must be taken to ensure that there is a sufficient time interval between administration and chemotherapy or radiotherapy, so that the high antioxidant capacity of Eumetabol® does not reduce the effectiveness of the chemotherapy or radiotherapy.*

Customised additions and condition-specific combinations
Eumetabol® mono infusions can generally be combined very effectively with established standard orthomolecular therapies, even on the same day of treatment. In this case, we recommend administering Eumetabol® at the end of the infusion session.

S-acetyl-glutathione in the scientific spotlight: Key findings of the study

Although ME/CFS was classified by the WHO as a disorder of the nervous system as early as 1969, for a long time researchers paid little attention to the clinical picture or attributed the symptoms to psychosomatic causes. It was only in the context of the COVID-19 pandemic and its health consequences that severe fatigue came to the attention of the scientific community. It is now accepted that there is a causal link between viral infections and ME/CFS, as well as between viruses and cancer, with impaired glutathione metabolism and the resulting disruption to NK cell homeostasis at the heart of the pathophysiological processes. The key research findings, which are likely to be relevant to other GSH deficiency disorders as well, are presented below.

Eumetabol® for inhibiting viral adsorption and virus-cell fusion

The glutathione redox reaction is involved in various cellular mechanisms, including the cell's own detoxification processes, the transport of amino acids, the production of coenzymes, and the recycling of vitamins E and C. Furthermore, reduced glutathione (GSH) acts as a redox buffer that maintains the reduced intracellular environment.[60]

▶ By modulating the oxidative state of cellular domains, GSH can disrupt the entry of various viral strains into the host cell and thus inhibit infection.[51]

Eumetabol® for the inhibition of viral replication

High GSH levels reduce viral replication and thus the progression of diseases caused by various viral strains.[57] This occurs because they significantly inhibit the expression of viral glycoproteins, which are responsible for the release and infectivity of viral particles.[61]

▶ Maintaining high GSH levels significantly inhibits viral replication in the body. The virus concentration falls.[57; 61]

Eumetabol® to maintain Th1/Th2 balance

Another consequence of falling glutathione levels is the activation of redox-sensitive transcription factors such as NF-κB. Downstream signal transduction promotes the expression of viral genes. Immune cells – such as macrophages – with low glutathione levels elicit an M2-like immune response, which triggers an enhanced TH2 reaction via specific interleukins.[62]

▶ Glutathione can help ensure a balanced immune response by regulating the TH1/TH2 balance.[62]

Eumetabol® to promote antigen processing

Glutathione modulates the response of antigen-presenting cells (APCs). Proteins that are phagocytosed by APC must be either denatured or partially unfolded before they can be cleaved by endopeptidases. The rate-limiting step in the partial unfolding of most antigens is the reduction of disulphide bonds. GSH is essential both for this reduction and for maintaining the activity of various enzymes, such as thiol proteases.[51]

▶ GSH thus plays a key role in the process of presenting antigen fragments on APCs.[51]

Eumetabol® for the reduction of cytopathic effects

> *"Many viruses induce oxidative stress to facilitate their replication within the cell. These viruses have developed the ability to influence specific signalling pathways to their advantage – by manipulating or suppressing them – in order to regulate ROS concentrations."*[28]

In viral infections and a wide range of other conditions, intracellular glutathione levels fall, partly due to a very rapid loss of GSH from the cells immediately following infection,[63] and partly due to the increase in inflammatory cytokines such as TNF-α in the tissue.[51] The drop in GSH concentration as a redox buffer leads to a disruption of the cells' oxidative state, as the generation of reactive oxygen species (ROS) is increased.[28] The oxidative stress caused by these ROS leads to an acceleration of the cell cycle, potentially resulting in DNA damage, cellular senescence and apoptosis.[56] Additional cellular damage arises from the GSH loss described above, even in the absence of ROS activity. A physiological GSH level can prevent or reduce these cytopathic effects. Glutathione and other thiols also neutralise the effects of peroxynitrite-mediated DNA damage by forming stable GSH-DNA adducts.[6]

▶ Increasing intracellular glutathione levels can therefore be described as a therapeutic target in viral infections and their long-term consequences.[6; 56; 64; 65]

S-acetyl-glutathione (Eumetabol®): a study of influenza, AIDS and herpes simplex

> *"In some viral infections, such as HIV, influenza and HSV, the reduction in cellular GSH represents a mechanism by which the virus can evade the immune response."*[9]

Reduced glutathione inhibits the expression of matrix proteins in influenza viruses. At the same time, it inhibits caspase activation and the upregulation of FasR (CD95) induced by the virus. GSH has been shown to be effective against influenza in vitro and in vivo.[65]

SAG enhances the efficacy of AZT (azidothymidine)[57; 69; 70], an antiretroviral drug which, as a nucleoside reverse transcriptase inhibitor, inhibits the replication of human immunodeficiency virus (HIV) in animal models.

In vitro, SAG reduces the likelihood of infection with herpes simplex virus type 1 (HSV-1) by restoring intracellular GSH levels, and in vivo (in an animal model) it reduces virus-induced mortality.[50]

The restoration of intracellular glutathione levels was more efficient following administration of SAG than following administration of GSH, other GSH derivatives or individual amino acids. A reduction in HSV-1-induced mortality was achieved solely through the administration of SAG. Conventional reduced glutathione proved to be ineffective for this purpose.[50]

▸ Particularly given the annual recurrence of viral outbreaks, S-acetyl-glutathione (Eumetabol®) can be used to boost the immune system in general. It also has a direct antiviral effect. It can therefore help protect against infections and reduce the duration and severity of symptoms should an illness occur.[56; 57; 71]

S-Acetyl-Glutathione (Eumetabol®) in the context of COVID-19

COVID-19, a respiratory disease caused by the SARS-CoV-2 coronavirus, presents a multidisciplinary challenge. A wide range of research fields are investigating the condition, its long-term effects – such as chronic fatigue (ME/CFS, post-viral fatigue) – and various treatment options. International specialist publications describe a close link between low glutathione levels and severe disease progression, as well as post-COVID.[7; 9; 15; 64; 72]

> *"GSH deficiency plays a key role in the pathophysiology of inflammatory diseases and COVID-19, as well as in the host's immune response, disease severity and mortality. Treatments that raise GSH levels could become a cornerstone in reducing the severity and fatal outcomes of inflammatory diseases, as well as COVID-19. Raising GSH levels could prevent and curb these diseases."*[64]

Eumetabol® for the prevention of COVID-19

> *"The importance of pulmonary GSH levels in reducing the risk of infection is demonstrated by the fact that impaired GSH biosynthesis and function compromises the host's immune response. Consequently, reduced blood GSH levels and impaired GSH detoxification function in the lungs are associated with more severe courses of COVID-19."*[15]

Glutathione plays a crucial role in the pathogenesis of COVID-19 by modulating the body's response to the infection. Key factors here are considered to be, above all, the disrupted redox homeostasis associated with intracellular glutathione deficiency and the associated increased oxidative stress, particularly in the lungs, which ultimately leads to serious manifestations such as acute respiratory distress syndrome, multiple organ failure and death in COVID-19 patients.[33]

The same study highlights the importance of glutathione for endogenous vitamin D biosynthesis.[33] Through complex mechanisms, the vitamin plays a role in defending against pathogenic microorganisms, for example by supporting the synthesis of antimicrobial peptides via 25-hydroxyvitamin D.[73; 74] Low levels of 25-hydroxyvitamin D are associated with increased susceptibility to respiratory infections.[73]

▶ Low glutathione levels are the most plausible explanation for the severe symptoms and deaths seen in COVID-19 patients. It appears that the degree of glutathione reduction correlates inversely with the rate of viral replication (low GSH levels → high viral load).[14; 33; 38; 75]

Eumetabol® for the treatment of COVID-19

> *"Restoring glutathione levels in COVID-19 patients could be a promising approach to managing the novel coronavirus SARS-CoV-2.."*[33]

> *"The level of glutathione (GSH) […] could be crucial in inhibiting the excessive inflammatory response that triggers organ failure in COVID-19."*[36]

Numerous studies have demonstrated the antiviral effects of glutathione – both in relation to SARS-CoV-2 and viral diseases in general.[9; 15; 16; 19; 21; 24; 26; 28; 33; 36; 42–46; 50; 51; 56–58; 60–62; 64; 69; 70; 72; 76] Horowitz et al. report on the efficacy of glutathione therapy in alleviating respiratory distress in the context of COVID-19 pneumonia.[23] This effect is likely due to the fact that glutathione supplementation prevents the cytokine storm in the lungs. These findings are supported, among other things, by studies and biochemical investigations that describe the protective role of glutathione against ROS-mediated inflammatory reactions.[5; 6; 15; 36]

▶ Low levels of glutathione are thought to be a major cause of excessive inflammatory responses in severe cases of COVID-19. This suggests that raising intracellular GSH levels could reduce the number of symptomatic patients.

Eumetabol® for the prevention and treatment of long COVID

What are the long-term effects?

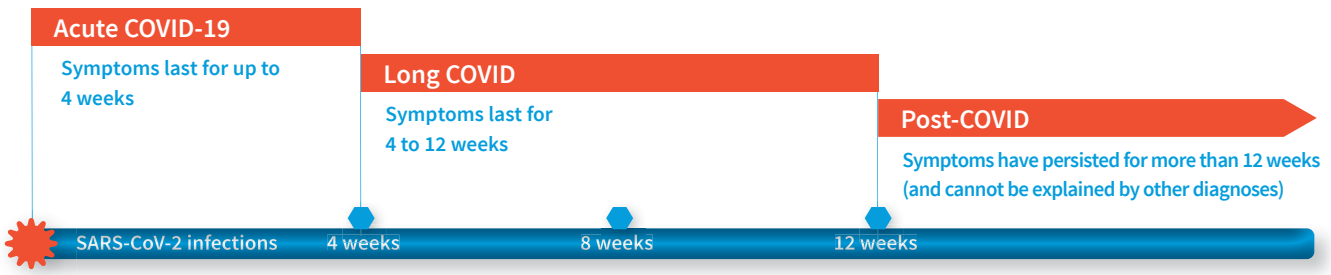
Research is now being conducted internationally into a cluster of symptoms known as long COVID or post-COVID. The term "long COVID" is used when symptoms persist for more than four weeks after the onset of the illness. In post-COVID syndrome, patients continue to experience symptoms (or experience a recurrence of symptoms) for longer than twelve weeks after the onset of the illness. Characteristic features include persistent or recurrent symptoms, primarily involving fatigue, low mood, headaches, problems with memory and concentration, taste disturbances, breathing difficulties and general malaise, with no correlation to the severity of the viral infection.[20; 25; 29; 31; 37; 77–96]

Some patients also suffer from persistent, extreme fatigue that cannot be alleviated by sleep following other viral illnesses. This set of symptoms is referred to as post-viral fatigue.[97]

ME/CFS (myalgic encephalomyelitis/chronic fatigue syndrome) is regarded as a distinct neuroimmunological condition, which is also characterised by extremely rapid physical and mental exhaustion and a high intolerance to physical exertion. ME/CFS can occur, amongst other things, as a possible comorbidity of long and post-COVID, or as the sole long-term consequence of a SARS-CoV-2 infection.[98]

- **COVID-19 infection: acute symptoms lasting up to 4 weeks**
- **Long COVID: symptoms typical of COVID-19 that persist or develop for a period of 4-12 weeks following the acute illness**
- **Post-COVID: symptoms typical of COVID-19 persisting more than 12 weeks after the acute illness (persistent or newly emerging, not attributable to other diagnoses)**
- **Post-viral fatigue: "physical, mental and/or emotional exhaustion that is disproportionate to the exertion that preceded it and cannot be alleviated by sleep"[97] following viral infections (influenza, measles, Ebola, various coronaviruses, etc.)**
- **ME/CFS: a distinct neuroimmunological condition that generally persists for life, characterised by fatigue lasting at least six months, often triggered by an infection**

The ICD-10 classifies Chronic Fatigue Syndrome (CFS), Myalgic Encephalomyelitis (ME) and post-viral fatigue under code G93.3.[99]



Overview of COVID-19 terminology
(according to the National Institute for Health and Care Excellence / NICE)

Case numbers

International studies arrive at differing case figures due to variations in their designs – one systematic review estimates the prevalence of long and post-COVID to be at least 10%[13], whilst British long-term studies report post-COVID in 7.8-17% of COVID-19 patients[100]. Other studies suggest far higher case figures.

Another striking finding is the high proportion of COVID-19 patients who subsequently develop ME/CFS. Severe fatigue is one of the most common problems following a SARS-CoV-2 infection.[24; 25; 31; 39; 42–46; 79–81; 88; 91; 96; 101; 102] According to a large-scale meta-analysis, around one-third of COVID patients continue to suffer from persistent, severe fatigue weeks after the illness; over one-fifth still exhibit cognitive impairments twelve weeks or more later. Unlike other long-term effects, which may be self-limiting, both of these problems appear to have a tendency to persist and even to worsen.[103]

The symptoms persist even in cases where the virus is no longer detectable. However, studies have shown that elevated levels of inflammatory markers can still be detected in the blood weeks after infection.[35]

Pathomechanisms, prevention and treatment options

Despite significant advances in medical and biochemical research, the pathomechanisms underlying these symptoms have not yet been fully elucidated. Among other things, the following are being discussed: a prolonged healing phase of systemic endotheliitis; an excessive inflammatory response (cytokine storm), which may also reactivate dormant viruses in the body (e.g. herpes, EBV); and a possible autoimmune reaction.[12; 80; 93; 104] Some scientists believe that SARS-CoV-2 can also directly trigger ME/CFS.[105–107]

From a pathogenetic perspective, there is considerable evidence to suggest a malfunction of the immune system, particularly as post-viral fatigue is not specific to SARS-CoV-2 – it has already been documented in connection with the Epstein-Barr virus (EBV)[27] and with SARS-CoV-1[106; 108]: Even following a SARS-CoV-1 infection, a good 40%[109] or over 50%[110] of those affected suffered from long-term fatigue.

▶ Post-viral fatigue (ME/CFS) is one of the most common problems following infection with SARS-CoV-2. SAG (Eumetabol®), a compounded medication that has been tried and tested for decades in the treatment of fatigue-related conditions, can offer reliable relief in such cases, particularly as it also has anti-inflammatory, antiviral and immunomodulatory properties and helps protect against further potential long-term damage.

Eumetabol® for the prevention of further complications

Scientists are increasingly identifying and investigating further long-term effects that occur following SARS-CoV-2 infection. Studies suggest that a GSH deficiency plays a key role in the development of severe SARS-CoV-2 disease involving immune thrombosis.[18] In COVID-19 patients – unlike in other conditions that trigger this response – immune thrombosis affects multiple organs and numerous blood vessels simultaneously, and therefore contributes significantly to severe disease progression.

> *"The combination of various adverse effects of GSH deficiency in conditions such as COVID-19 suggests that a reduction in GSH is a key mechanism in the immune thrombosis cascade."*[18]

Furthermore, it has been demonstrated that there are close pathophysiological links between low GSH levels in the anterior cingulate cortex, the occurrence of white matter lesions (WMLs) in the brain, and depressive symptoms following SARS-CoV-2 infection. It is believed that effectively raising GSH levels may reduce the harmful effects of COVID-19 on the brain, as well as the neuropsychiatric consequences of the disease.[32]

▶ We are still far from understanding all the mechanisms underlying these diseases and the potential long-term effects of COVID-19 and other viral illnesses. However, it is already known that the glutathione system, and thus intracellular GSH levels, play a central role in numerous pathological mechanisms. Effective glutathione therapy, such as that provided by S-acetyl-glutathione (Eumetabol®), therefore represents a crucial treatment option and also offers the possibility of effectively preventing long-term effects that may not yet be known.

Dr. med. Gerhard Ohlenschläger® Pioneer and leading figure in glutathione therapy

"Life is nothing but a degenerative process."

PD Dr. med. habil. Gerhard Ohlenschläger, Specialist in Internal Medicine, Clinical Chemistry and Surgery; Biochemist

Dr Ohlenschläger (1930-2008) is the "inventor" of the active pharmaceutical ingredient S-acetyl-glutathione (Eumetabol®). For decades, he devoted himself to a detailed study of the role of the glutathione redox system in the prevention and treatment of a wide range of diseases. Cancer was a key focus of his work.[111–121] The findings of his research formed the basis for groundbreaking new therapeutic approaches. Many of his medical and therapeutic developments involving the active ingredient glutathione have been patented.

Dr Ohlenschläger was the first to apply the acetylation process to reduced glutathione, enabling it to be used effectively in medicine as SAG (Eumetabol®). His more than 30 years of scientific research and development remain the foundation upon which successful and long-lasting glutathione infusion therapy is based: with Eumetabol®.

PD Dr. med. habil. Gerhard Ohlenschläger

- 30 years of research into glutathione
- 16 monographs
- 250 specialist publications, including on glutathione, glutathione therapy, oxidative stress, biological cancer therapies, pathobiochemical topics and many more.
- Research focus: modulation of the glutathione redox system for the prevention and treatment of various diseases
- Developer of the method for acetylating GSH:
  - Longer half-life
  - Acetyl protecting group prevents the oxidation of GSH
  - Acetyl protecting group prevents negative feedback on glutathione synthetase

Since Dr Ohlenschläger developed SAG, numerous independent studies have demonstrated that SAG (Eumetabol®) can effectively and sustainably increase intracellular glutathione levels. Prompted by the COVID-19 pandemic, research into glutathione has once again been significantly stepped up, confirming the outstanding scientific insights and achievements of this renowned physician and biochemist many years after his death.

Eumetabol®: quality unrivalled anywhere in the world

When it comes to glutathione therapy in particular, it is important to ensure you are using the highest quality product. It is crucial for efficacy and safety that the highest standards regarding the purity and concentration of the active ingredient are met. Eumetabol® meets these requirements thanks to its active pharmaceutical ingredient, S-acetyl-glutathione (SAG), which is manufactured exclusively for Eumetabol® **in accordance with the strictest GMP guidelines**:

- active pharmaceutical ingredient, specially developed for medical use
- Developed over more than 30 years of glutathione research
- The highest purity ensures the fastest and most lasting effect
- Tested by an external and independent quality control laboratory
- Entirely manufactured in Germany, with guaranteed consistent quality and purity
  - Compliance with the strictest national, European and international guidelines
  - Manufacturing processes verified by regulatory inspections
  - All legal requirements for active pharmaceutical ingredients are met (an important distinction from all counterfeit products)
  - The active ingredient in every single batch of Eumetabol® is thoroughly tested and certified by a detailed, valid certificate of analysis in accordance with the Pharmacy Operating Regulations
  - Validated test methods in accordance with recognised pharmaceutical standards
- Research and application supported by a scientific advisory board comprising doctors, scientists and other experts
- A pioneer in high-dose therapy for chronic fatigue syndrome and other fatigue-related conditions

Quality guaranteed: external audit by PSM GmbH

PSM GmbH is an external and independent contract manufacturer of active pharmaceutical ingredients and sterile medicinal products, certified in accordance with Section 13 of the German Medicines Act (AMG), with an in-house **quality control laboratory** that performs regular analyses of pharmaceutical raw materials and finished medicinal products to the highest standards. PSM GmbH tests the active ingredient in every batch of Eumetabol® for identity, purity and content using established and validated analytical methods and in accordance with pharmaceutical regulations.

PSM GmbH uses only the most advanced, state-of-the-art equipment, which is regularly calibrated and maintained, to test its products, thereby ensuring the reliability of the data collected. Our highly qualified staff receive ongoing training through internal and external courses and development programmes. Regular GMP inspections certify that PSM GmbH complies with GMP guidelines.

This is how we ensure the highest product quality and patient safety – a key distinguishing feature in global glutathione therapy.

PSM

Eumetabol®: Highest standards in manufacturing, consultancy and distribution

Eumetabol® glutathione infusions, containing the active pharmaceutical ingredient S-acetyl-glutathione, as well as the other infusions mentioned in this specialist information sheet, are available as **compounded medicines of GMP-compliant quality** from Viktoria Apotheke in Saarbrücken. No other glutathione supplement in the world uses this pharmaceutical-grade active ingredient at this proven highest quality level.

Viktoria Apotheke Saarbrücken, under the management of Dr Fritz Trennheuser, has many years of experience in the preparation of parenteral preparations such as solutions for injection and infusion. For many years, it has been supplying doctors, alternative practitioners and patients with products manufactured in-house under sterile conditions, based on prescribed formulations. In doing so, it ensures compliance with the highest manufacturing and quality standards.

The pharmacy's extensive range of formulations includes solutions for injection and infusion containing antioxidants and polyphenols, as well as amino acids, vitamins and many other ingredients. This makes Viktoria Apotheke Saarbrücken a trusted partner in the manufacture of Eumetabol® glutathione infusions.

Eumetabol® glutathione infusions are

- prescription-only medicines manufactured exclusively in Germany
- in accordance with the strictest GMP directives.

A medical prescription is required for the administration of Eumetabol® glutathione infusions.

As these products are manufactured exclusively in Germany, the restrictions that apply to imports from other European countries (AMG Section 73/3) do not apply to Eumetabol® formulations in the first place.

Thanks to its well-organised manufacturing and logistics processes, Viktoria Apotheke Saarbrücken guarantees extremely short delivery times for ready-to-infuse solutions, thereby providing optimal support for your practice's planning processes. In addition, the pharmacy team is on hand to provide you with personalised advice and help you plan your treatment plans.

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Dr. Trennheuser OHG

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References

1. Flohé L. Glutathione. Boca Raton: CRC Press; 2018
2. Perjési P. Glutathione: biosynthesis, functions and biological implications. Hauppauge (USA): Nova Science; 2019
3. Böhm U, Reuss F. Zellschutz – Entgiftung – Prävention: die gesundheitliche Bedeutung von Glutathion. 2nd ed. Bremen, London, Boston: UNI-MED; 2019
4. Aquilano K, Baldelli S, Ciriolo MR. Glutathione: new roles in redox signaling for an old antioxidant. Front Pharmacol 2014;5:196
5. Di Paola R, Modafferi S, Siracusa R, et al. S-acetyl-glutathione attenuates carbon tetrachloride-induced liver injury by modulating oxidative imbalance and inflammation. Int J Mol Sci 2022;23(8):4429
6. Ahmed N, Chakrabarty A, Guengerich FP, et al. Protective role of glutathione against peroxynitrite-mediated DNA damage during acute inflammation. Chem Res Toxicol 2020;33(10):2668–2674
7. Al-Hakeim HK, Al-Rubaye HT, Al-Hadrawi DS, et al. Long-COVID post-viral chronic fatigue and affective symptoms are associated with oxidative damage, lowered antioxidant defenses and inflammation: a proof of concept and mechanism study. Mol Psychiatry 2023;28(2):564–578
8. Alexander J, Tinkov A, Strand TA, et al. Early nutritional interventions with zinc, selenium and vitamin D for raising anti-viral resistance against progressive COVID-19. Nutrients 2020;12(8):2358
9. Bartolini D, Stabile AM, Bastianelli S, et al. SARS-CoV-2 infection impairs the metabolism and redox function of cellular glutathione. Redox Biol 2021;45:102041
10. Bermano G, Méplan C, Mercer DK, et al. Selenium and viral infection: are there lessons for COVID-19? Br J Nutr 2021;125(6):618–627
11. Cao R, Hu H, Li Y, et al. Anti-SARS-CoV-2 potential of artemisinins in vitro. ACS Infect Dis 2020;6(9):2524–2531
12. Chen T, Song J, Liu H, et al. Positive Epstein-Barr virus detection in coronavirus disease 2019 (COVID-19) patients. Sci Rep 2021;11(1):10902
13. Davis HE, McCorkell L, Vogel JM, et al. Long COVID: major findings, mechanisms and recommendations. Nat Rev Microbiol 2023;21(3):133–146
14. De Flora S, Balansky R, La Maestra S. Rationale for the use of N-acetylcysteine in both prevention and adjuvant therapy of COVID-19. FASEB J 2020;34(10):13185–13193
15. Galli F, Marcantonini G, Giustarini D, et al. How aging and oxidative stress influence the cytopathic and inflammatory effects of SARS-CoV-2 infection: the role of cellular glutathione and cysteine metabolism. Antioxidants 2022;11(7):1366
16. Galmés S, Serra F, Palou A. Current state of evidence: influence of nutritional and nutrigenetic factors on immunity in the COVID-19 pandemic framework. Nutrients 2020;12(9):2738
17. Gendrot M, Andreani J, Boxberger M, et al. Antimalarial drugs inhibit the replication of SARS-CoV-2: An in vitro evaluation. Travel Med Infect Dis 2020;37:101873
18. Glassman I, Le N, Mirhosseini M, et al. The role of glutathione in prevention of COVID-19 immunothrombosis: a review. Front Biosci Landmark Ed 2023;28(3):59
19. Guloyan V, Oganesian B, Baghdasaryan N, et al. Glutathione supplementation as an adjunctive therapy in COVID-19. Antioxidants 2020;9(10):914
20. Halpin SJ, McIvor C, Whyatt G, et al. Postdischarge symptoms and rehabilitation needs in survivors of COVID-19 infection: a cross-sectional evaluation. J Med Virol 2021;93(2):1013–1022
21. Hiffler L, Rakotoambinina B. Selenium and RNA virus interactions: potential implications for SARS-CoV-2 Infection (COVID-19). Front Nutr 2020;7:164
22. Hooper PL. COVID-19 and heme oxygenase: novel insight into the disease and potential therapies. Cell Stress Chaperones 2020;25(5):707–710
23. Horowitz RI, Freeman PR, Bruzzese J. Efficacy of glutathione therapy in relieving dyspnea associated with COVID-19 pneumonia: a report of 2 cases. Respir Med Case Rep 2020;30:101063
24. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The Lancet 2020;395(10223):497–506
25. Islam MF, Cotler J, Jason LA. Post-viral fatigue and COVID-19: lessons from past epidemics. Fatigue Biomed Health Behav 2020;8(2):61–69
26. Khanfar A, Al Qaroot B. Could glutathione depletion be the Trojan horse of COVID-19 mortality? Eur Rev Med Pharmacol Sci 2020;24(23):12500–12509
27. Kristiansen MS, Stabursvik J, O'Leary EC, et al. Clinical symptoms and markers of disease mechanisms in adolescent chronic fatigue following Epstein-Barr virus infection: an exploratory cross-sectional study. Brain Behav Immun 2019;80:551–563
28. Kumar DS, Hanumanram G, Suthakaran PK, et al. Extracellular oxidative stress markers in COVID-19 patients with diabetes as co-morbidity. Clin Pract 2022;12(2):168–176
29. Mandal S, Barnett J, Brill SE, et al. "Long-COVID": a cross-sectional study of persisting symptoms, biomarker and imaging abnormalities following hospitalisation for COVID-19. Thorax 2021;76(4):396–398
30. Mrityunjaya M, Pavithra V, Neelam R, et al. Immune-boosting, antioxidant and anti-inflammatory food supplements targeting pathogenesis of COVID-19. Front Immunol 2020;11:570122
31. Perrin R, Riste L, Hann M, et al. Into the looking glass: post-viral syndrome post COVID-19. Med Hypotheses 2020;144:110055

32. Poletti S, Paolini M, Mazza MG, et al. Lower levels of glutathione in the anterior cingulate cortex associate with depressive symptoms and white matter hyperintensities in COVID-19 survivors. Eur Neuropsychopharmacol 2022;61:71–77
33. Polonikov A. Endogenous deficiency of glutathione as the most likely cause of serious manifestations and death in COVID-19 patients. ACS Infect Dis 2020;6(7):1558–1562
34. Saleh MG, Chang L, Liang H, et al. Ongoing oxidative stress in individuals with post-acute sequelae of COVID-19. NeuroImmune Pharmacol Ther 2023;2(2):89–94
35. Schultheiß C, Paschold L, Simnica D, et al. Next-generation sequencing of T and B cell receptor repertoires from COVID-19 patients showed signatures associated with severity of disease. Immunity 2020;53(2):442-455.e4
36. Silvagno F, Vernone A, Pescarmona GP. The role of glutathione in protecting against the severe inflammatory response triggered by COVID-19. Antioxidants 2020;9(7):624
37. Simpson R, Robinson L. Rehabilitation after critical illness in people with COVID-19 infection. Am J Phys Med Rehabil 2020;99(6):470–474
38. Sureda A, Alizadeh J, Nabavi SF, et al. Endoplasmic reticulum as a potential therapeutic target for COVID-19 infection management? Eur J Pharmacol 2020;882:173288
39. Tian S, Hu N, Lou J, et al. Characteristics of COVID-19 infection in Beijing. J Infect 2020;80(4):401–406
40. Townsend DM, Tew KD, Tapiero H. The importance of glutathione in human disease. Biomed Pharmacother Biomedecine Pharmacother 2003;57(3–4):145–155
41. Varga Z, Flammer AJ, Steiger P, et al. Endothelial cell infection and endotheliitis in COVID-19. The Lancet 2020;395(10234):1417–1418
42. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323(11):1061
43. Xu X-W, Wu X-X, Jiang X-G, et al. Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARS-CoV-2) outside of Wuhan, China: retrospective case series. BMJ 2020;368:m606
44. Zhang JJ, Dong X, Cao YY, et al. Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan, China. Allergy 2020;75(7):1730–1741
45. Zhu J, Ji P, Pang J, et al. Clinical characteristics of 3062 COVID-19 patients: a meta-analysis. J Med Virol 2020;92(10):1902–1914
46. Zhu J, Zhong Z, Ji P, et al. Clinicopathological characteristics of 8697 patients with COVID-19 in China: a meta-analysis. Fam Med Community Health 2020;8(2):e000406
47. Cramer-Scharnagl D. Glutathion: unverzichtbar für die Entgiftung, effektiv bei chronischer Erschöpfung, schützt Mitochondrien und Zellen. 2nd ed. Kirchzarten: VAK; 2016
48. Wendel A, Cikryt P. The level and half-life of glutathione in human plasma. FEBS Lett 1980;120(2):209–211
49. Aebi S, Assereto R, Lauterburg BH. High-dose intravenous glutathione in man. Pharmacokinetics and effects on cyst(e)ine in plasma and urine. Eur J Clin Invest 1991;21(1):103–110
50. Vogel J-U, Cinatl J, Dauletbaev N, et al. Effects of S-acetyl-glutathione in cell and animal model of herpes simplex virus type 1 infection. Med Microbiol Immunol (Berl) 2005;194(1–2):55–59
51. Fraternale A, Brundu S, Magnani M. Glutathione and glutathione derivatives in immunotherapy. Biol Chem 2017;398(2):261–275
52. Fanelli S, Francioso A, Cavallaro R, et al. Oral administration of S-acetyl-glutathione: impact on the levels of glutathione in plasma and in erythrocytes of healthy volunteers. Int J Clin Nutr Diet 2018;4(2)
53. Marianetti M, Pinna S, Venuti A, et al. Olive polyphenols and bioavailable glutathione: promising results in patients diagnosed with mild Alzheimer's disease. Alzheimers Dement Transl Res Clin Interv 2022;8(1):e12278
54. Geiger RE. S-Acetyl-Glutathion (Eumetabol®) versus reduziertes Glutathion: Vergleichsstudie zur In-vivo-Halbwertszeit. (Eigenstudie)
55. Okun JG, Sauer S, Bähr S, et al. S-Acetylglutathione normalizes intracellular glutathione content in cultured fibroblasts from patients with glutathione synthetase deficiency. J Inherit Metab Dis 2004;27(6):783–786
56. Lima JE. The role of glutathione in viral diseases of the central nervous system. In: Erkekoglu P, Kocer-Gumusel B, eds. Glutathione in health and disease. London: InTech; 2018:65–81
57. Fraternale A, Paoletti MF, Casabianca A, et al. Inhibition of murine AIDS by pro-glutathione (GSH) molecules. Antiviral Res 2008;77(2):120–127
58. Palamara AT, Brandi G, Rossi L, et al. New synthetic glutathione derivatives with increased antiviral activities. Antivir Chem Chemother 2004;15(2):77–85
59. Cacciatore I, Cornacchia C, Pinnen F, et al. Prodrug approach for increasing cellular glutathione levels. Molecules 2010;15(3):1242–1264
60. Fraternale A, Paoletti M, Casabianca A, et al. Antiviral and immunomodulatory properties of new pro-glutathione (GSH) molecules. Curr Med Chem 2006;13(15):1749–1755
61. Palamara AT, Perno CF, Ciriolo MR, et al. Evidence for antiviral activity of glutathione: in vitro inhibition of herpes simplex virus type 1 replication. Antiviral Res 1995;27(3):237–253
62. Brundu S, Palma L, Picceri GG, et al. Glutathione depletion is linked with Th2 polarization in mice with a retrovirus-induced immunodeficiency syndrome, murine AIDS: role of proglutathione molecules as immunotherapeutics. J Virol 2016;90(16):7118–7130
63. Ciriolo MR, Palamara AT, Incerpi S, et al. Loss of GSH, oxidative stress, and decrease of intracellular pH as sequential steps in viral infection. J Biol Chem 1997;272(5):2700–2708

64. Labarrere CA, Kassab GS. Glutathione: a Samsonian life-sustaining small molecule that protects against oxidative stress, ageing and damaging inflammation. Front Nutr 2022;9:1007816
65. Cai J, Chen Y, Seth S, et al. Inhibition of influenza infection by glutathione. Free Radic Biol Med 2003;34(7):928–936
66. Locigno R, Pincemail J, Henno A, et al. S-acetyl-glutathione selectively induces apoptosis in human lymphoma cells through a GSH-independent mechanism. Int J Oncol 2002;20(1):69–75
67. Guerra L. The antioxidant glutathione as a regulator of natural killer cell immunity [Univ. Diss.]. Luxembourg: University of Luxembourg; 2021
68. Lane DP. Cancer. p53, guardian of the genome. Nature 1992;358(6381):15–16
69. Palamara AT, Garaci E, Rotilio G, et al. Inhibition of murine AIDS by reduced glutathione. AIDS Res Hum Retroviruses 1996;12(14):1373–1381
70. Magnani M, Fraternale A, Casabianca A, et al. Antiretroviral effect of combined zidovudine and reduced glutathione therapy in murine AIDS. AIDS Res Hum Retroviruses 1997;13(13):1093–1099
71. Herzenberg LA, De Rosa SC, Dubs JG, et al. Glutathione deficiency is associated with impaired survival in HIV disease. Proc Natl Acad Sci 1997;94(5):1967–1972
72. Labarrere CA, Kassab GS. Glutathione deficiency in the pathogenesis of SARS-CoV-2 infection and its effects upon the host immune response in severe COVID-19 disease. Front Microbiol 2022;13:979719
73. Martineau AR, Jolliffe DA, Hooper RL, et al. Vitamin D supplementation to prevent acute respiratory tract infections: systematic review and meta-analysis of individual participant data. BMJ 2017;356:i6583
74. Teymoori-Rad M, Shokri F, Salimi V, et al. The interplay between vitamin D and viral infections. Rev Med Virol 2019;29(2):e2032
75. D'Angelo JA, Dehlink E, Platzer B, et al. The cystine/glutamate antiporter regulates dendritic cell differentiation and antigen presentation. J Immunol 2010;185(6):3217–3226
76. Morris D, Khurasany M, Nguyen T, et al. Glutathione and infection. Biochim Biophys Acta BBA - Gen Subj 2013;1830(5):3329–3349
77. Baig AM. Chronic COVID syndrome: need for an appropriate medical terminology for long-COVID and COVID long-haulers. J Med Virol 2021;93(5):2555–2556
78. Campbell J. Fears over thousands of "long haul" COVID-19 sufferers. The Scotsman 2020. https://www.scotsman.com/regions/fears-over-thousands-of-long-haul-covid-19-sufferers-2884703. Accessed January 25, 2024
79. Carfì A, Bernabei R, Landi F, et al. Persistent symptoms in patients after acute COVID-19. JAMA 2020;324(6):603
80. Craig DJ. How COVID-19 could reveal the secrets of chronic fatigue syndrome. Columbia Mag 2020. https://magazine.columbia.edu/article/how-covid-19-could-reveal-secrets-chronic-fatigue-syndrome. Accessed January 25, 2024
81. Garner P. COVID-19 and fatigue – a game of snakes and ladders. BMJ Opin 2020. https://blogs.bmj.com/bmj/2020/05/19/paul-garner-COVID-19-and-fatigue-a-game-of-snakes-and-ladders/. Accessed January 25, 2024
82. Halpin S, O'Connor R, Sivan M. Long COVID and chronic COVID syndromes. J Med Virol 2021;93(3):1242–1243
83. Harding L. "It feels endless": four women struggling to recover from COVID-19. The Guardian 2020. https://www.theguardian.com/world/2020/jun/07/it-feels-endless-four-women-struggling-to-recover-from-covid-19-coronavirus-symptoms. Accessed January 25, 2024
84. Kamal M, Abo Omirah M, Hussein A, et al. Assessment and characterisation of post-COVID-19 manifestations. Int J Clin Pract 2021;75:e13746
85. Kingstone T, Taylor AK, O'Donnell CA, et al. Finding the "right" GP: a qualitative study of the experiences of people with long-COVID. BJGP Open 2020;4(5):bjgpopen20X101143
86. Klok FA, Boon GJAM, Barco S, et al. The Post-COVID-19 Functional Status Scale: a tool to measure functional status over time after COVID-19. Eur Respir J 2020;56(1):2001494
87. Ky B, Mann DL. COVID-19 clinical trials: a primer for the cardiovascular and cardio-oncology communities. JACC Basic Transl Sci 2020;5(5):501–517
88. Lyons D, Frampton M, Naqvi S, et al. Fallout from the COVID-19 pandemic – should we prepare for a tsunami of post viral depression? Ir J Psychol Med 2020;37(4):295–300
89. Neufeld KJ, Leoutsakos J-MS, Yan H, et al. Fatigue symptoms during the first year following ARDS. Chest 2020;158(3):999–1007
90. Ngai JC, Ko FW, Ng SS, et al. The long-term impact of severe acute respiratory syndrome on pulmonary function, exercise capacity and health status. Respirology 2010;15(3):543–550
91. O'Connor CM. COVID-19 fatigue: not so fast. JACC Heart Fail 2020;8(7):592–594
92. Rogers JP, Chesney E, Oliver D, et al. Psychiatric and neuropsychiatric presentations associated with severe coronavirus infections: a systematic review and meta-analysis with comparison to the COVID-19 pandemic. Lancet Psychiatry 2020;7(7):611–627
93. Rubin R. As their numbers grow, COVID-19 "long haulers" stump experts. JAMA 2020;324(14):1381
94. Salisbury H. When will we be well again? BMJ 2020;369:m2490
95. Tansey CM. One-year outcomes and health care utilization in survivors of severe acute respiratory syndrome. Arch Intern Med 2007;167(12):1312
96. Williams FMK, Muirhead N, Pariante C. COVID-19 and chronic fatigue. BMJ 2020;370:m2922
97. Rabady S, Hoffmann K, Aigner M, et al. Leitlinie S1 für das Management postviraler Zustände am Beispiel Post-COVID-19. Wien Klin Wochenschr 2023;135(4):525–598

98. Renz-Polster H, Scheibenbogen C. Post-COVID-Syndrom mit Fatigue und Belastungsintoleranz: Myalgische Enzephalomyelitis bzw. Chronisches Fatigue-Syndrom. Inn Med 2022;63(8):830–839
99. ICD-10-GM-2024: G93.- Sonstige Krankheiten des Gehirns - icd-code.de. 2024. https://www.icd-code.de/suche/icd/code/G93.-.html?sp=SG93.3. Accessed February 13, 2024
100. Hallek M, Adorjan K, Behrends U, et al. Post-COVID syndrome. Dtsch Ärztebl Int 2023;120(4):48–55
101. Tenforde MW, Kim SS, Lindsell CJ, et al. Symptom duration and risk factors for delayed return to usual health among outpatients with COVID-19 in a multistate health care systems network – United States, March–June 2020. MMWR Morb Mortal Wkly Rep 2020;69(30):993–998
102. Assaf G, Davis H, McCorkell L, et al. Report: What does COVID-19 recovery actually look like? Patient-Led Res Collab 2020. https://patientresearchcovid19.com/research/report-1/. Accessed January 24, 2024
103. Ceban F, Ling S, Lui LMW, et al. Fatigue and cognitive impairment in Post-COVID-19 Syndrome: a systematic review and meta-analysis. Brain Behav Immun 2022;101:93–135
104. Franke C, Ferse C, Kreye J, et al. High frequency of cerebrospinal fluid autoantibodies in COVID-19 patients with neurological symptoms. Brain Behav Immun 2021;93:415–419
105. Townsend L, Dyer AH, Jones K, et al. Persistent fatigue following SARS-CoV-2 infection is common and independent of severity of initial infection. PLOS ONE 2020;15(11):e0240784
106. Wilson C. Concern coronavirus may trigger post-viral fatigue syndromes. New Sci 2020;246(3278):10–11
107. Bansal AS, Bradley AS, Bishop KN, et al. Chronic fatigue syndrome, the immune system and viral infection. Brain Behav Immun 2012;26(1):24–31
108. Moldofsky H, Patcai J. Chronic widespread musculoskeletal pain, fatigue, depression and disordered sleep in chronic post-SARS syndrome; a case-controlled study. BMC Neurol 2011;11(1):37
109. Lam MH-B. Mental morbidities and chronic fatigue in severe acute respiratory syndrome survivors – long-term follow-up. Arch Intern Med 2009;169(22):2142
110. Herridge MS, Cheung AM, Tansey CM, et al. One-year outcomes in survivors of the acute respiratory distress syndrome. N Engl J Med 2003;348(8):683–693
111. Ohlenschläger G. Freie Radikale, oxidativer Stress und Antioxidantien: krankheitsverursachende, präventive und reparative Prinzipien in lebenden Systemen. Cologne: Reglin; 1995
112. Dietl H, Ohlenschläger G. Handbuch der orthomolekularen Medizin: Prävention und Therapie durch körpereigene Substanzen. Heidelberg: Haug; 1994
113. Ohlenschläger G, Guzek G. Schach dem Herzinfarkt: wie Nährstoffe schützen. 2nd, rev. ed. Hamburg: Promedico; 1999
114. Ohlenschläger G. Wie entsteht Krebs? Programmänderungen der Zellteilungsmechanismen – Mutationen – Kanzerogenese – Onkogene. 2nd, exp. and rev. ed. Cologne: Reglin; 1998
115. Ohlenschläger G. Das Phänomen Krankheit. Cologne: Reglin; 1997
116. Ohlenschläger G. Hat der Zelltod auch mehrere Gesichter? Die Ambivalenz zwischen Nekrose und Apoptose. Cologne: Reglin; 1996
117. Glagau K, Ohlenschläger G. Vitalstoffe – Bausteine der Gesundheit. Heidelberg: Haug; 1994
118. Ohlenschläger G. Das Glutathionsystem: ordnungs- und informationserhaltende Grundregulation lebender Systeme. Heidelberg: Verl. für Medizin Fischer; 1991
119. Lippmann K, Ohlenschläger G, Stadtlaender H. Lehrbuch der hämatogenen Oxydationstherapie - HOT. Heidelberg: Haug; 1991
120. Ohlenschläger G, Berger I, Depner W. Synopsis der Elektrophoresetechniken. Darmstadt: G-I-T-Verlag Giebeler; 1980
121. Ohlenschläger G. Reaktionsweise der Blutfaktoren – Agglutinogene und Agglutinine – bei verschiedenen Erkrankungen [PhD thesis]. Frankfurt a.M.: Medical Faculty; 1960

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