

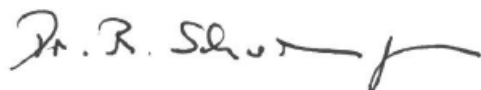
**SIGMA-ALDRICH®**Industriestrasse 25, CH-9471 Buchs (SG), Switzerland  
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## Certificate of Analysis

**Product Name:** AMINO ACIDS SUPPLEMENT, (6 AMINO ACIDS)  
-  
**Product Number:** 5062-2478  
**Batch Number:** BCBZ8451  
**Product Brand:** Sigma-Aldrich  
**Molecular Formula:**  
**Molecular Mass:**  
**CAS Number:**  
**Quality Release Date:** 13 DEC 2018  
**Expiration Date:** EXPIRY DATE PRINTED ON LABEL

**TEST****RESULTS**

<b>KIT-COMPOSITION PART 1</b>	99979 LOT BCBH3779V
<b>PART 2</b>	99980 LOT BCBZ6390
<b>PART 3</b>	99981 LOT BCBW4017
<b>PART 4</b>	99982 LOT BCBW4994
<b>PART 5</b>	99983 LOT BCBZ6240
<b>PART 6</b>	99984 LOT BCBT1641



Dr. Reinhold Schwenninger  
Quality Assurance  
Buchs, Switzerland

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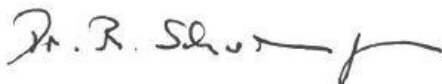
## Certificate of Analysis

**Product Name:** L-ASPARAGINE  
*BioUltra*  
**Product Number:** 99979  
**Batch Number:** BCBH3779V  
**Brand:** Sigma-Aldrich  
**CAS Number:** 70-47-3  
**Formula:**  
**Formula Weight:**  
**Quality Release Date:** 16 FEB 2012  
**Date retested:** 05 FEB 2019  
**Recommended Retest Date:** JAN 2023

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	COLORLESS OR WHITE	WHITE
APPEARANCE (FORM)	POWDER OR CRYSTALS	POWDER
TITRATION (NT) HClO <sub>4</sub> 0.1M	99.5 - 100.5 %	99.7 %
PURITY (TLC AREA %)	≥ 99.0 %	100.0 %
SPECIFIC ROTATION (20/D)	35.0 ± 0.5 DEGREES	34.8 DEGREES
CONCENTRATION	C=5 IN HCL 5M	C=5 IN HCL 5M
LOSS ON DRYING	≤ 0.1 %	< 0.05 %
RESIDUE ON IGNITION	≤ 0.05 %	< 0.05 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
ALUMINIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
BARIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
BISMUTH (ICP)	≤ 5 MG/KG	< 5 MG/KG
CALCIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
CADMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COBALT (ICP)	≤ 5 MG/KG	< 5 MG/KG
CHROMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COPPER (ICP)	≤ 5 MG/KG	< 5 MG/KG
IRON (ICP)	≤ 5 MG/KG	< 5 MG/KG
POTASSIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
LITHIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
MAGNESIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
MANGANESE (ICP)	≤ 5 MG/KG	< 5 MG/KG

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<b>MOLYBDENUM (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>SODIUM (ICP)</b>	≤ 50 MG/KG	< 50 MG/KG
<b>NICKEL (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>LEAD (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>STRONTIUM (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>ZINC (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>ARSENIC TRACES (MHS-AAS)</b>	≤ 0.1 MG/KG	< 0.050 MG/KG
<b>TOTAL SULFUR AS SO<sub>4</sub> (ICP)</b>	≤ 100 MG/KG	< 100 MG/KG
<b>CHLORIDE (CL)</b>	≤ 50 MG/KG	< 50 MG/KG
<b>SOLUBILITY (METHOD)</b>	0.396 G IN 30 ML H <sub>2</sub> O (0.1 M)	0.396 G IN 30 ML H <sub>2</sub> O (0.1 M)
<b>APPEARANCE (SOLUTION)</b>	CLEAR COLORLESS	CLEAR COLORLESS
<b>PH (SOLUTION)</b>	4.0 - 5.5	5.2
<b>RESIDUE (FILTER TEST)</b>	NO RESIDUE	NO RESIDUE
<b>UV - ABS. AT 260 NM</b>	≤ 0.07	0.004
<b>UV - ABS. AT 280 NM</b>	≤ 0.06	0.002



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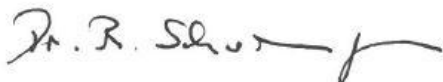
## Certificate of Analysis

**Product Name:** L-GLUTAMINE  
*BioUltra*  
**Product Number:** 99980  
**Batch Number:** BCBZ6390  
**Brand:** Sigma-Aldrich  
**CAS Number:** 56-85-9  
**Formula:**  $\text{H}_2\text{NCOCH}_2\text{CH}_2\text{CH}(\text{NH}_2)\text{CO}_2\text{H}$   
**Formula Weight:** 146.14  
**Quality Release Date:** 29 OCT 2018  
**Recommended Retest Date:** OCT 2022

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	COLORLESS OR WHITE	WHITE
APPEARANCE (FORM)	POWDER	POWDER
TITRATION (NT) HClO <sub>4</sub> 0.1M	99.5 - 100.5 %	100.3 %
THIN LAYER CHROMATOGR.	FOREIGN AMINO ACIDS ≤0.5%	CORRESPONDS
SPECIFIC ROTATION (20/D)	33.0 ± 1.0 DEGREES	34.0 DEGREES
CONCENTRATION	C=5 IN HYDROCHLORIC ACID 5M	C=5 IN HYDROCHLORIC ACID 5M
MELTING POINT (DEC.)	187 - 197 C	188 C
LOSS ON DRYING	≤ 0.1 %	< 0.05%
SULFATED ASH	≤ 0.1 %	< 0.05%
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
ALUMINIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
BARIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
BISMUTH (ICP)	≤ 5 MG/KG	< 5 MG/KG
CALCIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
CADMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COBALT (ICP)	≤ 5 MG/KG	< 5 MG/KG
CHROMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COPPER (ICP)	≤ 5 MG/KG	< 5 MG/KG
IRON (ICP)	≤ 5 MG/KG	< 5 MG/KG
POTASSIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
LITHIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
MAGNESIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG

## Certificate of Analysis

<b>MANGANESE (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>MOLYBDENUM (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>SODIUM (ICP)</b>	≤ 50 MG/KG	< 50 MG/KG
<b>NICKEL (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>LEAD (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>STRONTIUM (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>ZINC (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>ARSENIC TRACES (MHS-AAS)</b>	≤ 0.1 MG/KG	< 0.1MG/KG
<b>CHLORIDE (CL)</b>	≤ 50 MG/KG	< 50MG/KG
<b>SULFATE (SO4)</b>	≤ 50 MG/KG	< 50MG/KG
<b>SOLUBILITY (METHOD)</b>	--	0.438 G IN 30 ML H2O (0.1 M)
<b>APPEARANCE (SOLUTION)</b>	CLEAR COLORLESS	CLEAR COLORLESS
<b>PH (SOLUTION)</b>	5.0 - 6.0	5.3
<b>RESIDUE (FILTER TEST)</b>	NO RESIDUE	NO RESIDUE
<b>UV - ABS. AT 260 NM</b>	≤ 0.01	0.003
<b>UV - ABS. AT 280 NM</b>	≤ 0.01	0.002



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Quality Assurance  
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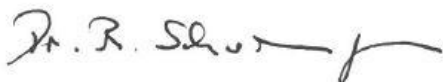
## Certificate of Analysis

**Product Name:** L-TRYPTOPHAN  
*BioUltra*  
**Product Number:** 99981  
**Batch Number:** BCBW4017  
**Brand:** Sigma-Aldrich  
**CAS Number:** 73-22-3  
**Formula:** C<sub>11</sub>H<sub>12</sub>N<sub>2</sub>O<sub>2</sub>  
**Formula Weight:** 204.23  
**Quality Release Date:** 16 JAN 2018  
**Recommended Retest Date:** DEC 2021

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	COLORLESS OR WHITE	WHITE
APPEARANCE (FORM)	POWDER OR CRYSTALS	POWDER
TITRATION (NT) HClO <sub>4</sub> 0.1M	99.5 - 100.5 %	100.3 %
SPECIFIC ROTATION (20/D)	-31.5 ± 1.0 DEGREES	-30.7 DEGREES
CONCENTRATION	C=1 IN WATER	C=1 IN WATER
MELTING POINT (DEC.)	280 - 290 C	282 C
LOSS ON DRYING	≤ 0.1 %	< 0.05%
SULFATED ASH	≤ 0.1 %	0.1 %
CARBON CONTENT	64.69 % (THEORY)	64.54 %
HYDROGEN CONTENT	5.92 % (THEORY)	5.92 %
NITROGEN CONTENT	13.72 % (THEORY)	13.63 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
ALUMINIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
BARIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
BISMUTH (ICP)	≤ 5 MG/KG	< 5 MG/KG
CALCIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
CADMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COBALT (ICP)	≤ 5 MG/KG	< 5 MG/KG
CHROMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COPPER (ICP)	≤ 5 MG/KG	< 5 MG/KG
IRON (ICP)	≤ 5 MG/KG	< 5 MG/KG
POTASSIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
LITHIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
MAGNESIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG

## Certificate of Analysis

<b>MANGANESE (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>MOLYBDENUM (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>SODIUM (ICP)</b>	≤ 50 MG/KG	< 50 MG/KG
<b>NICKEL (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>LEAD (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>STRONTIUM (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>ZINC (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>ARSENIC TRACES (MHS-AAS)</b>	≤ 0.1 MG/KG	< 0.1MG/KG
<b>TOTAL SULFUR AS SO4 (ICP)</b>	≤ 50 MG/KG	< 50 MG/KG
<b>CHLORIDE (CL)</b>	≤ 50 MG/KG	< 50MG/KG
<b>SOLUBILITY (METHOD)</b>	--	3.065 G IN 30 ML 0.5M HCL (0.5 M)
<b>APPEARANCE (SOLUTION)</b>	CLEAR, COLORLESS TO FAINTLY YELLOW	CLEAR COLORLESS
<b>RESIDUE (FILTER TEST)</b>	NO RESIDUE	NO RESIDUE
<b>CUT-OFF</b>	≤326 NM	317.7 NM



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## Certificate of Analysis

**Product Name:** L-4-HYDROXYPROLINE  
*BioChemika*

**Product Number:** 99982

**Batch Number:** BCBW4994

**Brand:** Sigma-Aldrich

**CAS Number:** 51-35-4

**Formula:**

**Formula Weight:**

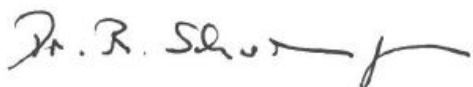
**Quality Release Date:** 29 JAN 2018

**Recommended Retest Date:** JAN 2022

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	COLORLESS OR WHITE	WHITE
APPEARANCE (FORM)	POWDER OR CRYSTALS	POWDER
TITRATION (NT) HClO <sub>4</sub> 0.1M	99.0 - 101.0 %	100.0 %
PURITY (TLC AREA %)	≥ 99.7 %	100.0 %
SPECIFIC ROTATION (20/D)	-76.0 ± 1.5 DEGREES	-75.5 DEGREES
CONCENTRATION	C=5 IN WATER	C=5 IN WATER
SOLUBILITY (COLOR)	COLORLESS	COLORLESS
SOLUBILITY (TURBIDITY)	CLEAR	CLEAR
SOLUBILITY (METHOD)	1G IN 10ML WATER	1G IN 10ML WATER
LOSS ON DRYING	≤ 0.1 %	< 0.05%
SULFATED ASH	≤ 0.1 %	< 0.05%
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
CALCIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
CADMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COBALT (ICP)	≤ 5 MG/KG	< 5 MG/KG
CHROMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COPPER (ICP)	≤ 5 MG/KG	< 5 MG/KG
IRON (ICP)	≤ 5 MG/KG	< 5 MG/KG
POTASSIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
MAGNESIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
MANGANESE (ICP)	≤ 5 MG/KG	< 5 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG

## Certificate of Analysis

<b>NICKEL (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>LEAD (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>ZINC (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>TOTAL SULFUR AS SO<sub>4</sub> (ICP)</b>	≤ 100 MG/KG	< 100 MG/KG
<b>CHLORIDE (CL)</b>	≤ 100 MG/KG	< 100MG/KG
<b>ION CHROMATOGRAPHY (NH<sub>4</sub><sup>+</sup>)</b>	≤ 100 MG/KG	< 100MG/KG



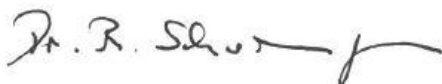
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Buchs, Switzerland

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## Certificate of Analysis

**Product Name:** L-NORVALINE  
*BioChemika*  
**Product Number:** 99983  
**Batch Number:** BCBZ6240  
**Brand:** Sigma-Aldrich  
**CAS Number:** 6600-40-4  
**Formula:** CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH(NH<sub>2</sub>)CO<sub>2</sub>H  
**Formula Weight:** 117.15  
**Quality Release Date:** 26 NOV 2018  
**Recommended Retest Date:** OCT 2022

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	COLORLESS OR WHITE	WHITE
APPEARANCE (FORM)	POWDER OR CRYSTALS	CRYSTALS
TITRATION (NT) HClO <sub>4</sub> 0.1M	99.0 - 101.0 %	100.0 %
THIN LAYER CHROMATOGR.	CORRESPONDS TO STANDARD	CORRESPONDS TO STANDARD
SPECIFIC ROTATION (20/D)	24.5 ± 1.5 DEGREES	24.7 DEGREES
CONCENTRATION	C=10 IN HYDROCHLORIC ACID 20%	C=10 IN HYDROCHLORIC ACID 20%
SOLUBILITY (COLOR)	COLORLESS	COLORLESS
SOLUBILITY (TURBIDITY)	CLEAR	CLEAR
SOLUBILITY (METHOD)	1G IN 10ML 5M HYDROCHLORIC ACID	1G IN 10ML 5M HYDROCHLORIC ACID
RESIDUE ON IGNITION	≤ 0.05 %	< 0.05 %
CARBON CONTENT	51.26 % (THEORY)	50.95 %
HYDROGEN CONTENT	9.46 % (THEORY)	9.35 %
NITROGEN CONTENT	11.96 % (THEORY)	12.26 %



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 Quality Assurance  
 Buchs, Switzerland

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## Certificate of Analysis

**Product Name:** SARCOSINE  
*BioUltra*  
**Product Number:** 99984  
**Batch Number:** BCBT1641  
**Brand:** Sigma-Aldrich  
**CAS Number:** 107-97-1  
**Formula:** CH<sub>3</sub>NHCH<sub>2</sub>COOH  
**Formula Weight:** 89.09  
**Quality Release Date:** 15 DEC 2016  
**Recommended Retest Date:** OCT 2020

TEST	SPECIFICATION	RESULT
APPEARANCE (COLOR)	COLORLESS OR WHITE	WHITE
APPEARANCE (FORM)	POWDER OR CRYSTALS	CRYSTALS
TITRATION (NT) HClO <sub>4</sub> 0.1M	99.0 - 101.0 %	99.0 %
LOSS ON DRYING	≤ 0.4 %	0.2 %
RESIDUE ON IGNITION	≤ 0.05 %	< 0.05 %
INFRARED SPECTRUM	CONFORMS TO STRUCTURE	CONFORMS
METAL TRACE ANALYSIS (ICP)	CORRESPONDS TO REQUIREMENTS	PASSED
ALUMINIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
BARIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
BISMUTH (ICP)	≤ 5 MG/KG	< 5 MG/KG
CALCIUM (ICP)	≤ 10 MG/KG	< 10 MG/KG
CADMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COBALT (ICP)	≤ 5 MG/KG	< 5 MG/KG
CHROMIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
COPPER (ICP)	≤ 5 MG/KG	< 5 MG/KG
IRON (ICP)	≤ 5 MG/KG	< 5 MG/KG
POTASSIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
LITHIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
MAGNESIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
MANGANESE (ICP)	≤ 5 MG/KG	< 5 MG/KG
MOLYBDENUM (ICP)	≤ 5 MG/KG	< 5 MG/KG
SODIUM (ICP)	≤ 50 MG/KG	< 50 MG/KG
NICKEL (ICP)	≤ 5 MG/KG	< 5 MG/KG
LEAD (ICP)	≤ 5 MG/KG	< 5 MG/KG
STRONTIUM (ICP)	≤ 5 MG/KG	< 5 MG/KG

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<b>ZINC (ICP)</b>	≤ 5 MG/KG	< 5 MG/KG
<b>ARSENIC TRACES (MHS-AAS)</b>	≤ 0.1 MG/KG	< 0.1 MG/KG
<b>TOTAL SULFUR AS SO<sub>4</sub> (ICP)</b>	≤ 50 MG/KG	< 50 MG/KG
<b>CHLORIDE (CL)</b>	≤ 600 MG/KG	600 MG/KG
<b>SOLUBILITY (METHOD)</b>	--	2.673 G IN 30 ML H <sub>2</sub> O (1 M)
<b>APPEARANCE (SOLUTION)</b>	CLEAR COLORLESS	CLEAR COLORLESS
<b>PH (SOLUTION)</b>	4.5 - 7.0	4.6
<b>RESIDUE (FILTER TEST)</b>	NO RESIDUE	NO RESIDUE
<b>UV - ABS. AT 260 NM</b>	≤ 0.2	0.103
<b>UV - ABS. AT 280 NM</b>	≤ 0.1	0.078



Dr. Claudia Geitner  
Manager Quality Control  
Buchs, Switzerland

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