



### TCA-Plus (Central Metabolism Profile)

**Service Code: TCAP**

**Summary:** Profile of Central Metabolism, including glycolysis, pentose-phosphate shunt, TCA cycle and nucleotide pools. LCMS detection includes a one step liquid-liquid organic solvent extraction of cultured cells, tissues or plasma, and separation on a 1mm x150mm HILIC specific column in a 35 min cycle. All analytes and Internal Standards are measured by ESI<sup>-</sup> ionization on a LC-QTOF mass spectrometer and reported as  $\mu\text{M}$  and normalized to wet tissue weight, volume or cell proteins. CV's are generally 15%.

In addition to Quantitative analysis of the TCA metabolites, the TCA Plus assay adds an additional semi-quantitative analysis of approximately 40 compounds found in most cell and tissue samples. These are shown in Table II.

**Container:** 1.5mL Micro Tube or equivalent

**Normal Volume:** Plasma (100  $\mu\text{L}$ ) Tissue (50-100 mg); Cell (1.5E7).

**Minimal Volume:** Plasma (50  $\mu\text{L}$ ) Tissue (30 mg); Cells (~2.5E6)

**Sample Collection:** Please see our detailed sample collection protocol on the Michigan Regional Comprehensive Metabolomics Resource Core (MRC<sup>2</sup>) website before preparing samples for analysis or contact the core director at the number below for details.

**Reference:** [Matthew A. Lorenz](#), [Charles F. Burant](#), and [Robert T. Kennedy](#) (2011) "Reducing Time and Increasing Sensitivity in Sample Preparation for Adherent Mammalian Cell Metabolomics", *Anal. Chem.* 83(9): 3406–3414.

Table I: Analytes reported with quantitative measurement (Additional Gly-TCA metabolites (Lactate, Fumarate, Alpha ketoglutarate) may be obtained for an additional cost by selecting TCA-Supplement in MiCores.)

Analyte	Abbr.	Mol Formula	LOQ( $\mu\text{M}$ )
Acetyl-CoA	aCoA	$\text{C}_{23}\text{H}_{38}\text{N}_7\text{O}_{17}\text{P}_3\text{S}$	1
Citrate/Isocitrate combined	Cit/i-Cit	$\text{C}_6\text{H}_8\text{O}_7$	1
Succinate	Suc	$\text{C}_4\text{H}_6\text{O}_4$	1
Malate	Mal	$\text{C}_4\text{H}_6\text{O}_5$	1
2-Phosphoglycerate/3-Phosphoglycerate combined	2PG/3PG	$\text{C}_3\text{H}_7\text{O}_7\text{P}$	1
Phosphoenolpyruvate	PEP	$\text{C}_3\text{H}_5\text{O}_6\text{P}$	1
Adenosine monophosphate	AMP	$\text{C}_{10}\text{H}_{14}\text{N}_5\text{O}_7\text{P}$	1
Adenosine diphosphate	ADP	$\text{C}_{15}\text{H}_{23}\text{N}_5\text{O}_{14}\text{P}_2$	1
Adenosine triphosphate	ATP	$\text{C}_{10}\text{H}_{16}\text{N}_5\text{O}_{13}\text{P}_3$	1
Flavin adenine dinucleotide	FAD	$\text{C}_{27}\text{H}_{33}\text{N}_9\text{O}_{15}\text{P}_2$	1



Table I, continued:

Nicotinamide adenine dinucleotide	NAD	C <sub>21</sub> H <sub>28</sub> N <sub>7</sub> O <sub>14</sub> P <sub>2</sub>	1
Nicotinamide adenine dinucleotide, reduced	NADH	C <sub>21</sub> H <sub>29</sub> N <sub>7</sub> O <sub>14</sub> P <sub>2</sub>	1
Nicotinamide adenine dinucleotide phosphate	NADP	C <sub>21</sub> H <sub>29</sub> N <sub>7</sub> O <sub>17</sub> P <sub>3</sub>	1
Nicotinamide adenine dinucleotide phosphate, reduced	NADPH	C <sub>21</sub> H <sub>30</sub> N <sub>7</sub> O <sub>17</sub> P <sub>3</sub>	1
Erythrose 4-phosphate	E4P	C <sub>4</sub> H <sub>9</sub> O <sub>7</sub> P	1
Ribulose 5-phosphate/Xylulose 5-phosphate/ribose-5-phosphate combined	R5P/X5P/Ru5P	C <sub>5</sub> H <sub>11</sub> O <sub>8</sub> P	1
6-phosphogluconate	6PG	C <sub>6</sub> H <sub>13</sub> O <sub>10</sub> P	1
Sedoheptulose 7-phosphate	S7P	C <sub>7</sub> H <sub>15</sub> O <sub>10</sub> P	1
Fructose-6-phosphate + glucose-6-phosphate	F6P/G6P	C <sub>6</sub> H <sub>13</sub> O <sub>9</sub> P	1
Fructose-bisphosphate	FBP	C <sub>6</sub> H <sub>14</sub> O <sub>12</sub> P <sub>2</sub>	1

NOTE: Metabolites in this assay may be below the detection limit in some samples, especially plasma and samples with less than 3 million cells.

**Table II: Additional metabolites reported for most cell or tissue samples in the TCA Plus assay as relative abundance**

Alanine and Aspartate Metabolism	Alanine
	Asparagine
	Aspartate
Aminosugar Metabolism	N-Acetyl-glucosamine-1-phosphate
Creatine Metabolism	Creatinine*
Food Component/Plant	Gluconate
Glutamate Metabolism	Glutamate
	Glutamine
Glutathione Metabolism	Glutathione, oxidized (GSSG)
	Glutathione, reduced (GSH)



**Table II cont'd:**

Glycine, Serine and Threonine Metabolism	3-Phospho-serine
	Serine
	Threonine
Glycolysis, Gluconeogenesis, and Pyruvate Metabolism	Hexose (glucose etc.)
Histidine Metabolism	Histidine
Leucine, Isoleucine and Valine Metabolism	Valine
Long Chain Fatty Acid	Oleic acid
	Palmitic acid
	Stearic acid
Lysine Metabolism	Lysine
Methionine, Cysteine, SAM and Taurine Metabolism	Methionine
	Taurine
Nucleotide Sugar	UDP-D-glucose
	UDP-D-glucuronate
	UDP-N-acetyl-D-glucosamine
Oxidative Phosphorylation	Acetylphosphate*
Pantothenate and CoA Metabolism	Pantothenate*
Phenylalanine and Tyrosine Metabolism	Phenylalanine
	Tyrosine
Purine Metabolism, (Hypo)Xanthine/Inosine containing	Inosine 5'-monophosphate (IMP)
	Inosine
	Xanthine
Purine Metabolism, Guanine containing	Guanosine diphosphate
Pyrimidine Metabolism, Cytidine containing	Cytidine monophosphate
Pyrimidine Metabolism, Uracil containing	Uridine 5'-diphosphate (UDP)
	Uridine 5'-monophosphate (UMP)
	Uridine 5'-triphosphate (UTP)
Tryptophan Metabolism	Tryptophan

NOTE: Metabolites in this assay may be below the detection limit in some samples, especially plasma and samples with less than 3 million cells; Compounds show with \* are usually only detected in tissue.