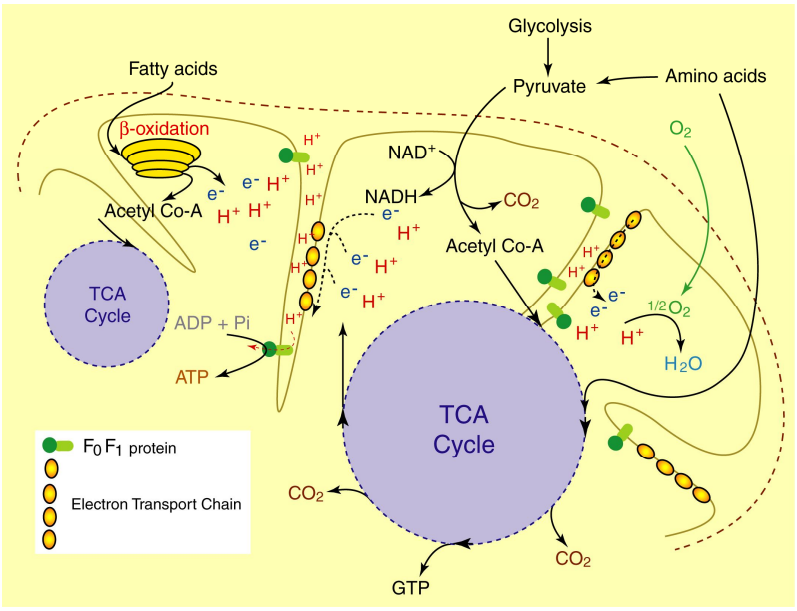
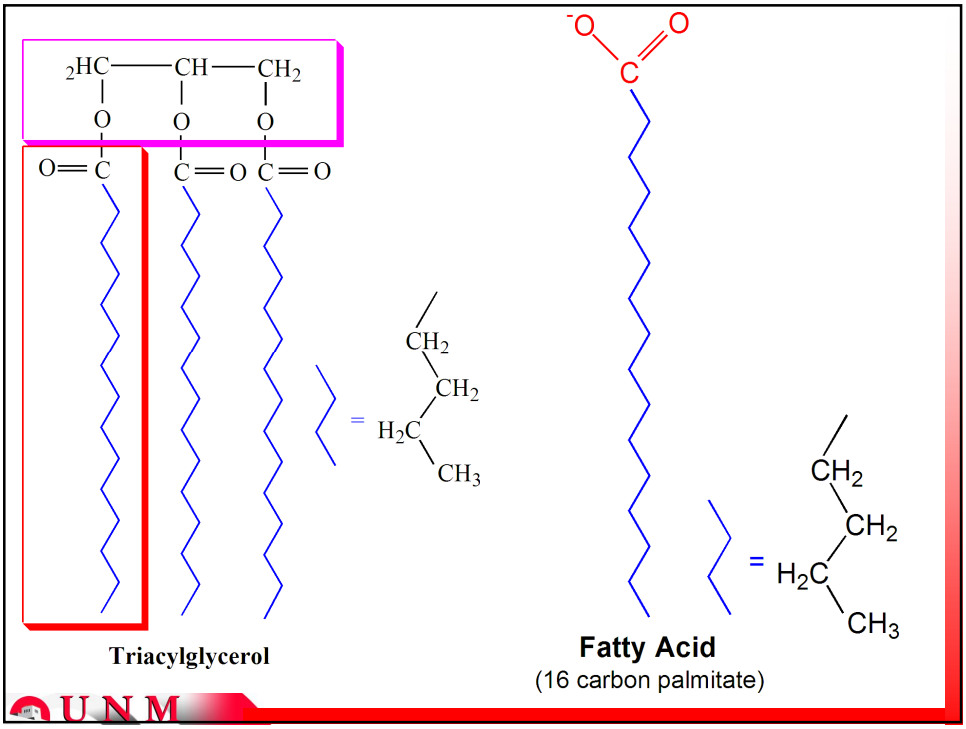
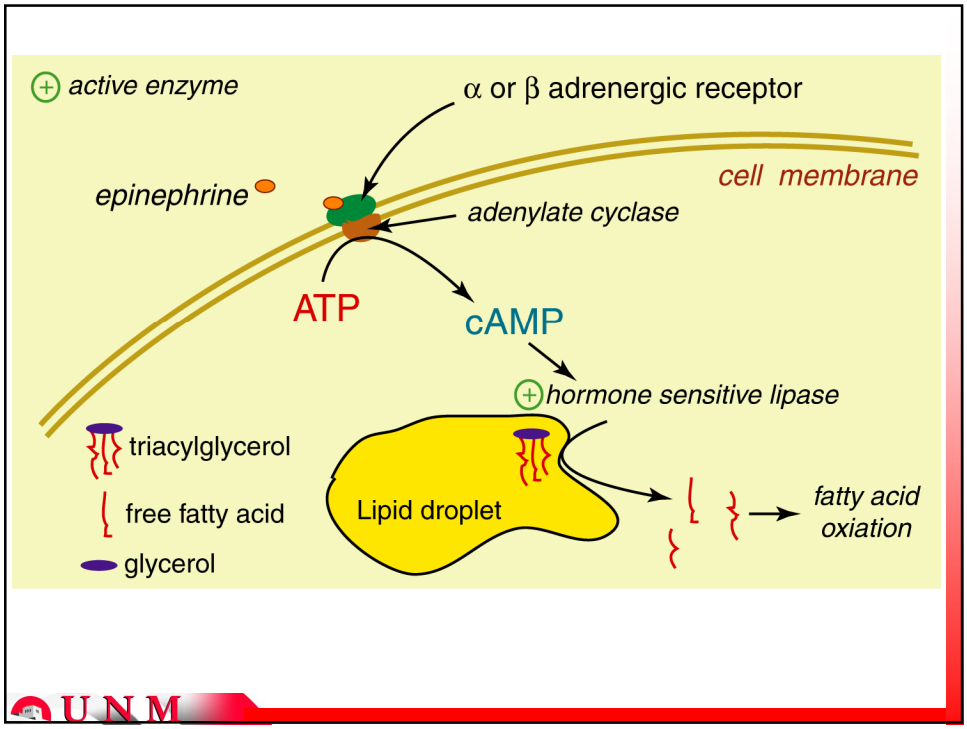
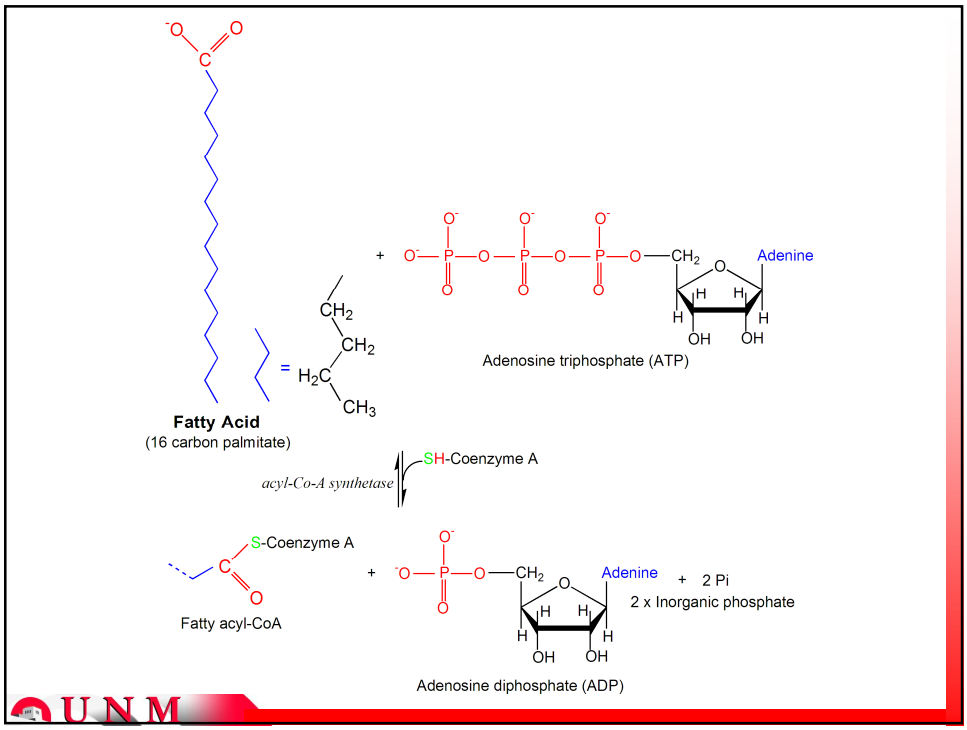
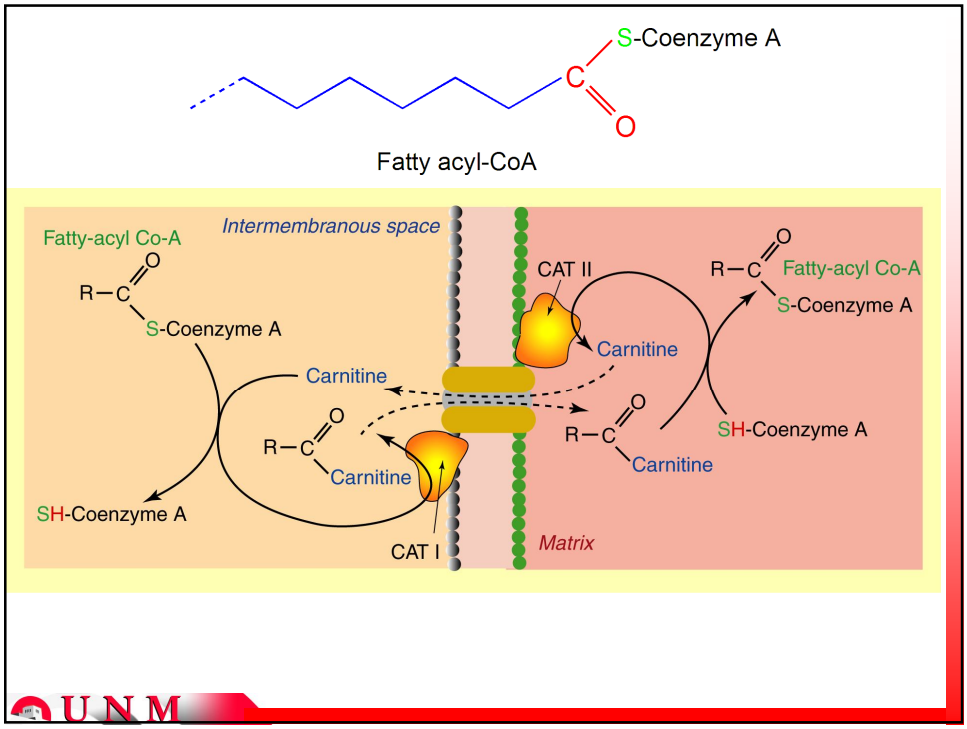
Comparing CHO to Fatty Acid Oxidation

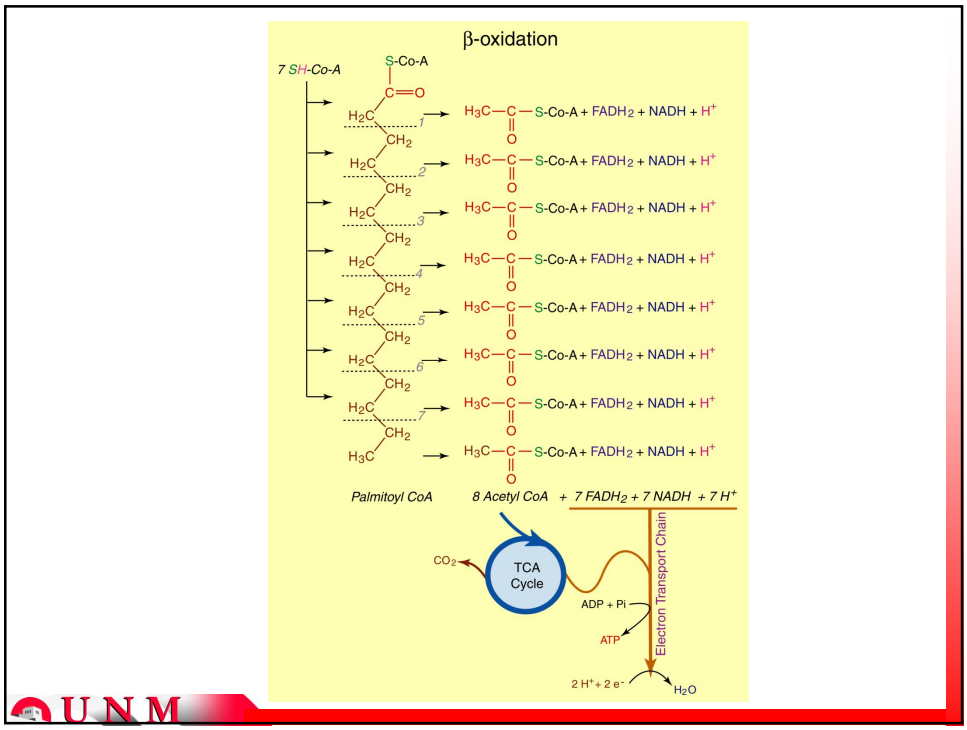





active enzyme
α or β adrenergic receptor
epinephrine
cell membrane
adenylate cyclase
ATP
cAMP
hormone sensitive lipase
triacylglycerol
free fatty acid
glycerol
Lipid droplet
fatty acid oxiation
UNM


Fatty Acid
(16 carbon palmitate)
Adenosine triphosphate (ATP)
acyl-Co-A synthetase
SH-Coenzyme A
S-Coenzyme A
Fatty acyl-CoA
Adenosine diphosphate (ADP)
2 x Inorganic phosphate
UNM


S-Coenzyme A
Fatty acyl-CoA
Fatty-acyl Co-A
S-Coenzyme A
Intermembranous space
CAT II
Carnitine
Fatty-acyl Co-A
S-Coenzyme A
Carnitine
SH-Coenzyme A
Carnitine
SH-Coenzyme A
CAT I
Matrix


β-oxidation
7 SH-Co-A
S-Co-A
Palmitoyl CoA
8 Acetyl CoA + 7 FADH2 + 7 NADH + 7 H+
TCA Cycle
CO2
ADP + Pi
ATP
Electron Transport Chain
2 H+ + 2 e-
H2O

ATP Production From Glucose vs. Palmitate Oxidation For 2 Acetyl CoA					
Glucose	**Product**	**ATP**	**Palmitate**	**Product**	**ATP**
To 2 acetyl CoA			*To 2 acetyl CoA*		
Glycolysis	2 NADH	4*	Fatty acid activation	-2 (2/8) ATP	-0.50
	2 ATP	2 or 3^	β-oxidation	2 (7/8) NADH	5.25
PDH complex	2 NADH	6		2 (7/8) FADH2	3.50
	2 CO2				
	Sub-Total	**12 or 13**		***Sub-Total***	**8.25**
From Oxidative Phosphorylation			*From Oxidative Phosphorylation*		
TCA cycle	6 NADH	18	TCA cycle	6 NADH	18
	2 FADH	4		2 FADH	4
	2 ATP	2		2 ATP	2
	4 CO2			4 CO2	
	Sub-Total	**24**		***Sub-Total***	**24**
	Totals	**36 or 37**		**Totals**	**32.25**

*assumes glycerol-3-phosphate shuttle; ^2 from glucose, 3 from glycogen. Note that 2 acetyl CoA molecules require 2 cycles of the TCA cycle.

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ATP Production From the Complete Oxidation of Glucose vs. Palmitate					
Glucose	**Product**	**ATP**	**Palmitate**	**Product**	**ATP**
Glycolysis	2 NADH	4*	Fatty acid activation	-2 ATP	-2
	2 ATP	2 or 3^	β-oxidation	7 NADH	21
PDH complex	2 NADH	6		7 FADH2	14
	2 acetyl CoA			8 acetyl CoA	
	2 CO2				
	Sub-Total	**12 or 13**		***Sub-Total***	**33**
From Oxidative Phosphorylation			*From Oxidative Phosphorylation*		
2 TCA cycles	6 NADH	18	8 TCA cycles	24 NADH	72
	2 FADH	4		8 FADH	16
	2 ATP	2		8 ATP	8
	4 CO2			16 CO2	
	Sub-Total	**24**		***Sub-Total***	**96**
	Totals	**36 or 37**		**Totals**	**129**

*assumes glycerol-3-phosphate shuttle; ^2 from glucose, 3 from glycogen

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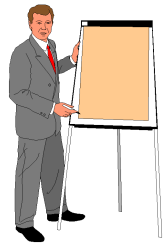

Which of CHO vs. fat yields the greatest number of ATP through 2 acetyl CoA oxidation?

Which of CHO vs. fat yields the greatest number of CO_2 through 2 acetyl CoA oxidation?

Respiratory Quotient = VO_2 / VCO_2

Which of CHO vs. fat has a lower RER? Why?

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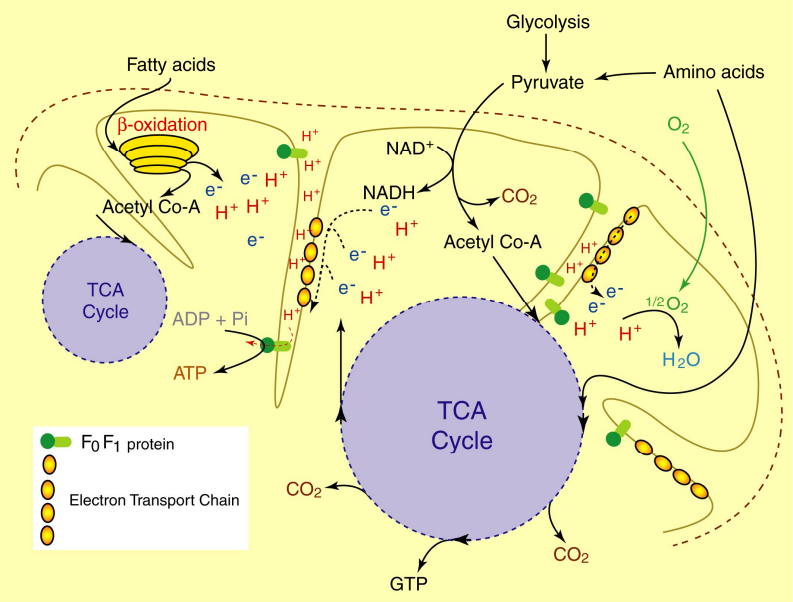
Nutrient Compound	Bomb Cal Kcals/gram	Body* Kcals/gram	RQ	Kcals/L VO_2
Carbohydrate				
Mixed	**4.1**	**4.0**	**1.0**	**5.05**
Glycogen	4.2		1.0	5.05
Glucose	3.7		1.0	4.98
Fructose	3.7		1.0	5.00
Glycerol	4.3		0.86	5.06
Fat				
Mixed	**9.3**	**9.0**	**0.7**	**4.73**
Palmitate (C16:0)	9.3		0.7	4.65
Stearate	9.5		0.69	4.65
Triacylglycerol (C18:0)	9.6		0.7	4.67
Triacylglycerol (C10-15:0)	8.4		0.74	4.69
Protein				
Mixed	**5.7**	**4.0**	**0.81**	**4.46**
Alanine	4.4		0.83	4.62
Aspartate	2.69		1.17	4.60
Glutamate	3.58		1.0	4.58
Isoleucine	6.89		0.73	4.64
Alcohol	**7.1**	**7.0**	**0.82**	**4.86**
Mixed Diet			0.84	4.83

* after Atwater correction factors (see text)

UNM

Amino Acid Oxidation



UNM

Nutrient Compound	Bomb Cal Kcals/gram	Body* Kcals/gram	RQ	Kcals/L VO_2
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Mixed	**4.1**	**4.0**	**1.0**	**5.05**
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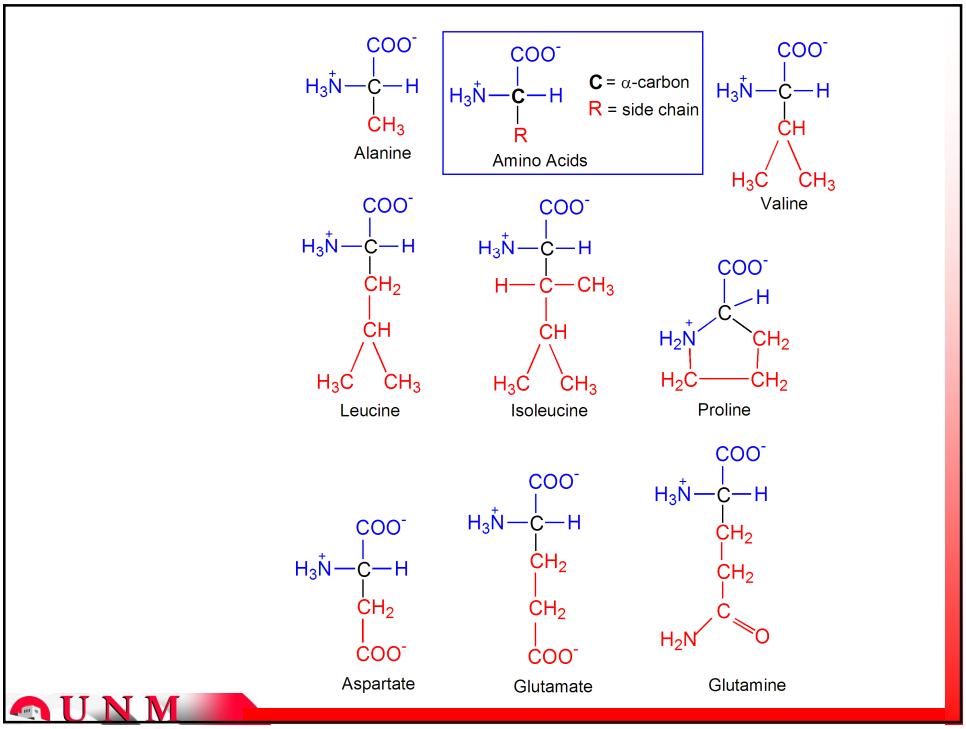
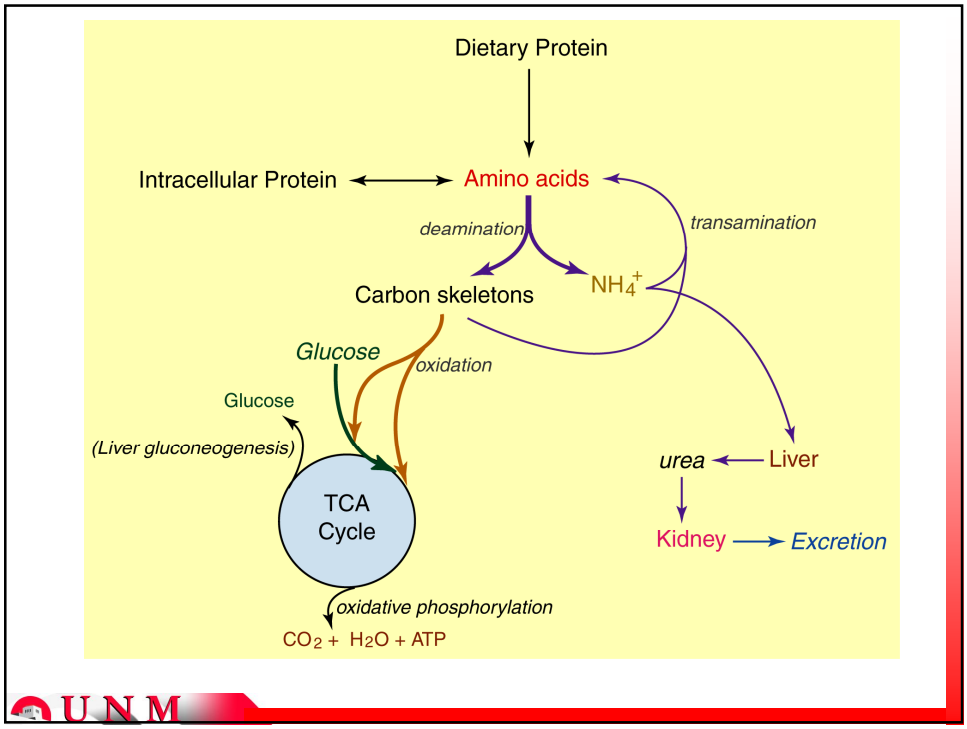
Isoleucine	6.89		0.73	4.64
Alcohol	**7.1**	**7.0**	**0.82**	**4.86**
Mixed Diet			0.84	4.83

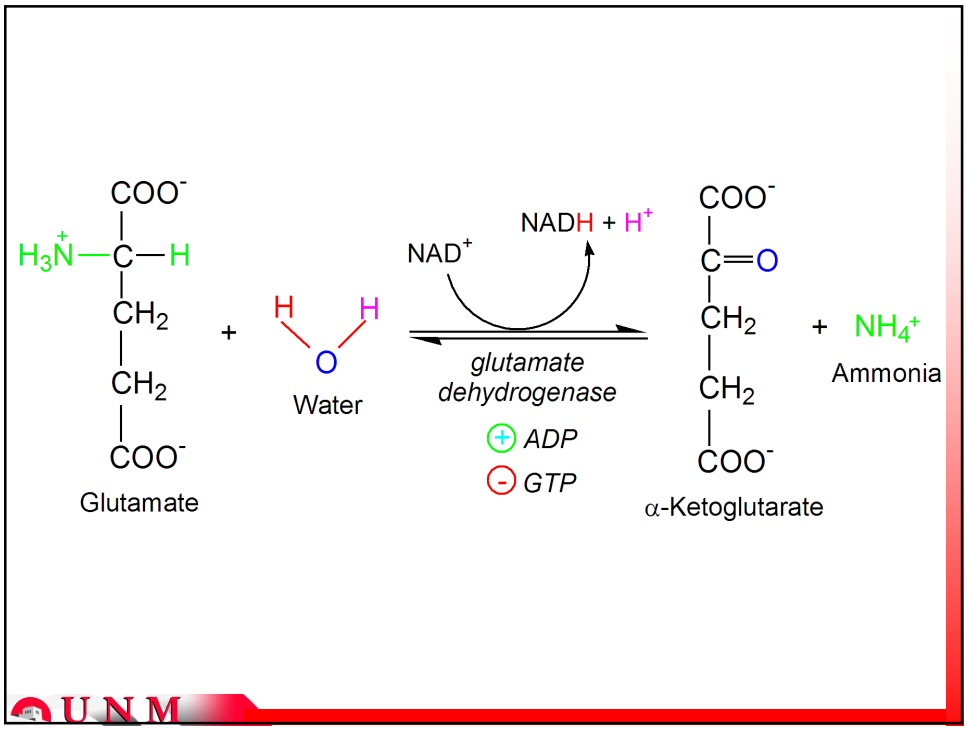
* after Atwater correction factors (see text)

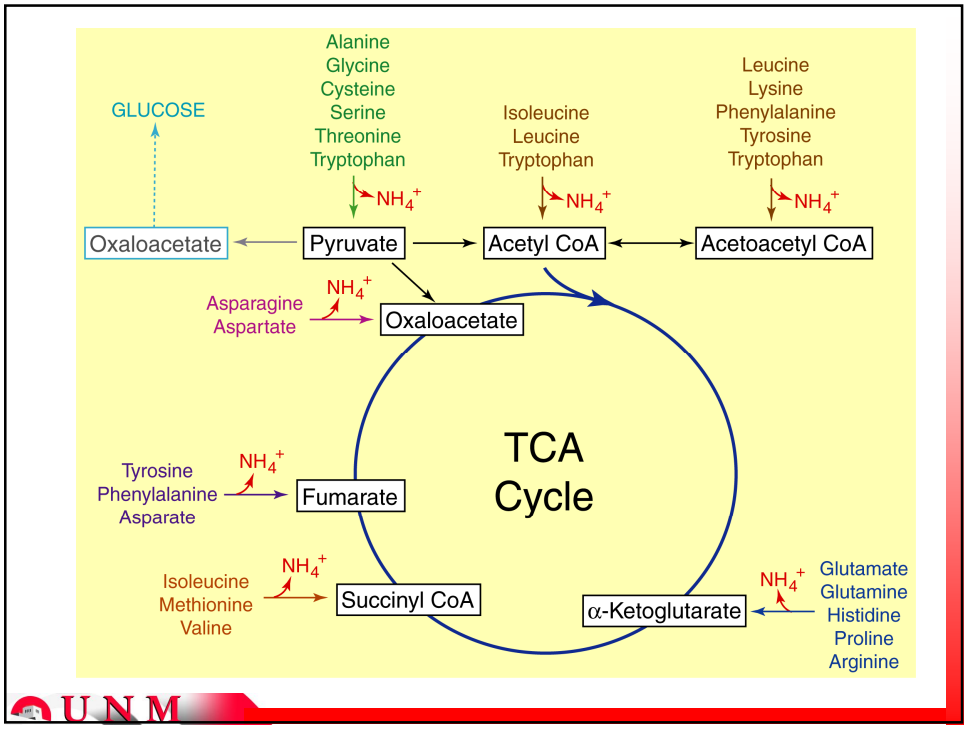
UNM

RER	Kcals/L	%CHO	CHO (Kcals)	%Fat	Fat (Kcals)
1.00	5.047	100	5.047	0	0
0.99	5.035	96.8	4.874	3.18	0.000
0.98	5.022	93.6	4.701	6.37	0.160
0.97	5.010	90.4	4.529	9.58	0.230
0.96	4.998	87.2	4.358	12.8	0.480
0.95	4.985	84.0	4.187	16.0	0.640
0.94	4.973	80.7	4.013	19.3	0.798
0.93	4.961	77.4	3.840	22.6	0.960
0.92	4.948	74.1	3.666	25.9	1.121
0.91	4.936	70.8	3.495	29.2	1.281
0.90	4.924	67.5	3.324	32.5	1.441
0.89	4.911	64.2	3.153	35.8	1.600
0.88	4.899	60.8	2.979	39.2	1.758
0.87	4.887	57.5	2.810	42.5	1.920
0.86	4.875	54.1	2.637	45.9	2.077
0.85	4.862	50.7	2.465	49.3	2.238
0.84	4.850	47.2	2.289	52.8	2.397
0.83	4.838	43.8	2.119	56.2	2.561
0.82	4.825	40.3	1.994	59.7	2.719
0.81	4.813	36.9	1.776	63.1	2.880
0.80	4.801	33.4	1.603	66.6	3.037
0.79	4.788	29.9	1.432	70.1	3.197
0.78	4.776	26.3	1.256	73.7	3.356
0.77	4.764	22.3	1.062	77.2	3.520
0.76	4.751	19.2	0.912	80.8	3.678
0.75	4.739	15.6	0.739	84.4	3.839
0.74	7.727	12.0	0.567	88.8	4.000
0.73	4.714	8.4	0.396	91.6	4.160
0.72	4.702	4.8	0.224	95.2	4.318
0.71	4.690	1.1	0.052	98.9	4.638
0.70	4.686	0	0.000	100	4.686




Dietary Protein
Intracellular Protein
Amino acids
deamination
transamination
NH_4^+
Carbon skeletons
Glucose
oxidation
Glucose
(Liver gluconeogenesis)
TCA Cycle
urea
Liver
Kidney
Excretion
oxidative phosphorylation
CO_2 + H_2O + ATP
UNM


Glutamate
Water
NAD^+
NADH + H^+
glutamate dehydrogenase
ADP
GTP
α-Ketoglutarate
Ammonia
UNM


Alanine
Glycine
Cysteine
Serine
Threonine
Tryptophan
Isoleucine
Leucine
Tryptophan
Leucine
Lysine
Phenylalanine
Tyrosine
Tryptophan
GLUCOSE
NH4+
Oxaloacetate
Pyruvate
Acetyl CoA
Acetoacetyl CoA
Asparagine
Aspartate
Oxaloacetate
TCA
Cycle
Tyrosine
Phenylalanine
Asparate
Fumarate
Isoleucine
Methionine
Valine
Succinyl CoA
α-Ketoglutarate
Glutamate
Glutamine
Histidine
Proline
Arginine
UNM