

Biolab reference: **PHWN\ABCD\A12**

Patient: **Mr Sample Patient**

Referred by: **Dr**

Date of birth: **16/01/969**

Your reference:

Sex: **Male**

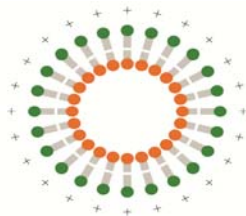
Date: **04/01/2012**

Sample date: **03/01/2012**

Erythrocyte Essential Fatty Acids

(fatty acid composition of erythrocytes reported as $\mu\text{mol/L}$ of red blood cells)

| ω-6 Fatty Acids | Result $\mu\text{mol/L}$ | Reference interval | | | | | | |
|--|------------------------------------|---------------------------|-------------|---------------|---------------|---------------|------|-------------|
| | | Low | High | Low | Normal | High | | |
| LA Linoleic acid | 869 | 500 | 1250 | | | | | |
| GLA Gamma-linolenic acid | 10.2 | 7.5 | 42.0 | | | | | |
| DGLA Dihomo-gamma-linolenic acid | 95 | 45 | 150 | | | | | |
| AA Arachidonic acid | 1042 | 440 | 1270 | | | | | |
| Adrenic Acid | 42.4 | 13.0 | 60.0 | | | | | |
| Eicosadienoic acid | 1.4 | 1.2 | 24.0 | | | | | |
| Docosadienoic acid | 3.3 | 1.0 | 18.0 | | | | | |
| ω-3 Fatty Acids | | | | Low | Normal | High | | |
| ALA Alpha-linolenic acid | 2.8 | 2.2 | 15.0 | | | | | |
| ETA Eicosatetraenoic acid | 0.9 | 0.7 | 4.5 | | | | | |
| EPA Eicosapentaenoic acid | 56 | 40 | 215 | | | | | |
| DHA Docosahexaenoic acid | 66 | 60 | 220 | | | | | |
| ω-5 Fatty Acids | | | | Normal | 1.25 | Raised | | |
| Myristoleic acid | 0.70 | ≤ 1.25 | | | | | | |
| ω-7 Fatty Acids | | | | Normal | 85.0 | Raised | | |
| Palmitoleic acid | 23.2 | ≤ 85.0 | | | | | | |
| | | | | Low | 15.0 | Normal | 35.0 | High |
| Cis-vaccenic acid | 24.8 | 15.0 | 35.0 | | | | | |



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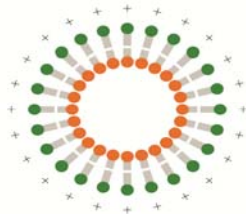
Date: **04/01/2012**

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Erythrocyte Essential Fatty Acids (continued)

(fatty acid composition of erythrocytes reported as $\mu\text{mol/L}$ of red blood cells)

| ω -9 Fatty Acids | Result | Reference interval | | | | |
|------------------------------|-------------------|--------------------|-------|-----|--------|------|
| | $\mu\text{mol/L}$ | Low | High | Low | Normal | High |
| Oleic Acid | 852 | 550 | 1300 | | | |
| Cis-11-eicosanoic acid | 18.3 | 9.0 | 20.0 | | | |
| Mead acid (20:3 n-9) | 17.0 | ≤ 30.0 | | | | |
| Erucic acid | 1 | ≤ 7 | | | | |
| Nervonic acid (24:1 n-9) | 4.2 | ≤ 5.0 | | | | |
| Saturated Fatty Acids | | | | | | |
| Lauric acid | 0.3 | ≤ 1.2 | | | | |
| Myristic acid | 17.5 | 15.0 | 120.0 | | | |
| Pentadecanoic acid | 5.5 | ≤ 16.0 | | | | |
| Palmitic acid | 1263 | 800 | 1900 | | | |
| Margaric acid | 19.0 | ≤ 26.0 | | | | |
| Stearic acid | 1007 | 620 | 1100 | | | |
| Arachidic acid | 9.7 | ≤ 16.0 | | | | |
| Heneicosanoic acid | 4.6 | 1.0 | 12.5 | | | |
| Behenic acid | 22 | 20 | 60 | | | |
| Lignoceric acid | 160 | 40 | 240 | | | |



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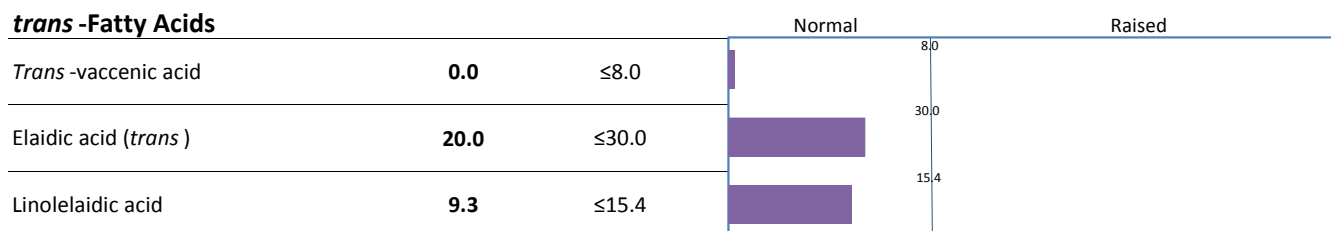
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Erythrocyte Essential Fatty Acids (continued)

(fatty acid composition of erythrocytes reported as $\mu\text{mol/L}$ of red blood cells)

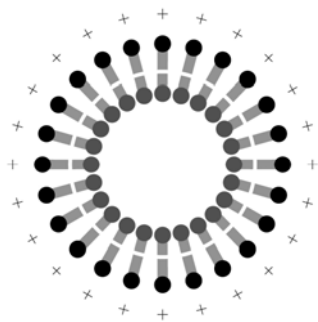
trans -Fatty Acids



| Ratios | Value | Reference Interval | Comment |
|---|--------------|--|---------------|
| AA/LA | 1.20 | <1.90 | |
| AA/EPA | 18.61 | <10.00 suggests enhanced fish or fish oil intake >20.00 suggests poor dietary intake of oily fish or fish oil | |
| AA/DHA | 15.79 | 4.50 - 12.50 | Raised |
| Omega 6 / Omega 3 | 16.41 | 5.00 - 16.00 | Raised |
| Polyunsaturated / Saturated | 0.88 | 0.50 - 1.10 | |
| Omega 3 index (total omega 3 fatty acids as a percentage of total) | 2.2% | >8.00% suggests a high cardioprotective effect | Low |

References

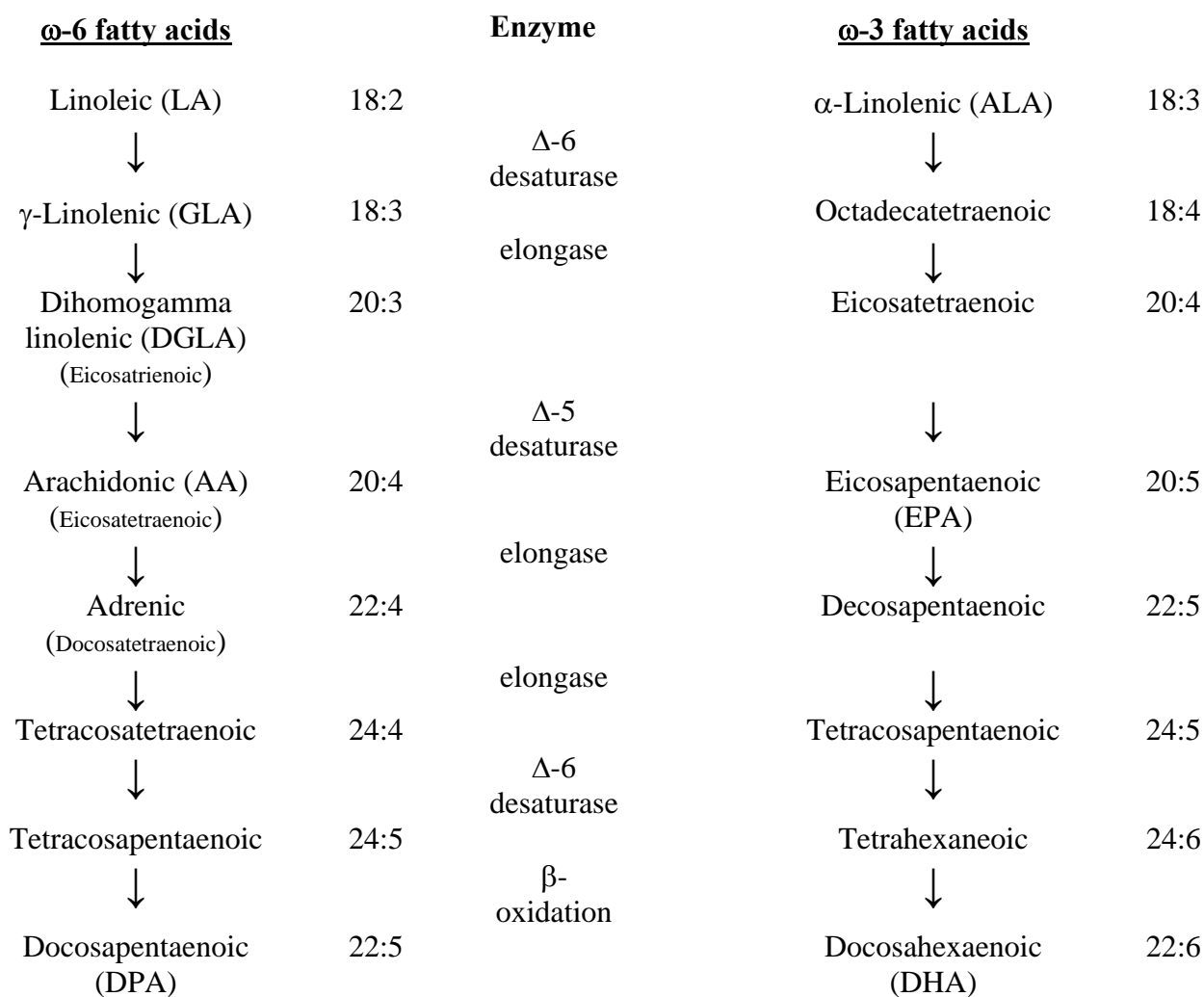
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- Harris WS, Lemke SL, Hansen SN et al. Stearidonic acid-enriched soybean oil increased the omega-3 index, an emerging cardiovascular risk marker. Lipids 2008;43:805-811.
- Cao J, Schwichtenberg KA, Hanson NQ, Tsai MY. Incorporation and clearance of omega-3 fatty acids in erythrocyte membranes and plasma phospholipids. Clin Chem 2006;52:2265-2271.

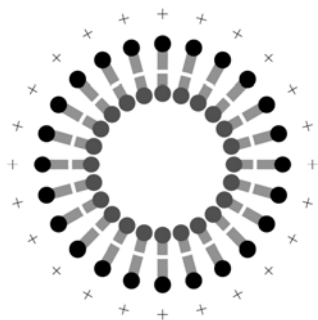


General Comments

Concentrations of red cell essential fatty acids below the indicated reference intervals are consistent with deficiencies of these substances. This can be caused by inadequate dietary intake, intestinal malabsorption or by impaired molecular transformations among the fatty acids (e.g. impaired conversion of linoleic to γ -linolenic acid secondary to a Δ -6 desaturase deficiency). Treatment of essential fatty acid deficiencies depends on the underlying cause and may include supplementation with appropriate ω -6 or ω -3 EFAs. Biochemical abnormalities may usually be detected before the onset of clinical manifestations, which include dermatitis, impaired wound healing and fatty infiltration of the liver with raised hepatic enzyme activities in the serum. Excess dietary fatty acids, particularly *trans* fatty acids, may also be associated with the development of cardiovascular disease.

To assist in the interpretation of results, a short schema of ω -6 and ω -3 fatty acid metabolism is shown below.





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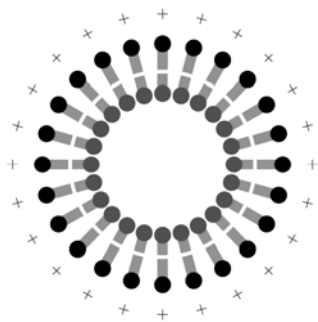
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| FATTY ACID common and systematic name | INFORMATION |
|---|---|
| Omega-6 essential fatty acids | |
| LA Linoleic acid (18:2 n-6) (<i>cis</i> -9,12-octadecadienoic acid) | LA and AA are the main essential omega-6 fatty acids, abundant in many vegetable oils. |
| GLA Gamma-linolenic acid (18:3 n-6) (<i>cis</i> -6,9,12-octadecatrienoic acid) | A major precursor for eicosanoid biosynthesis. From the seed of evening primrose (<i>Oenothera biennis</i>), also in blackcurrant, borage and hemp seed oils. Used in the treatment of inflammatory and autoimmune diseases. |
| DGLA Dihomo-gamma-linolenic acid (20:3 n-6) (<i>cis</i> -8,11,14-eicosatrienoic acid) | The elongation product of GLA, found only in trace amounts in animal products. Metabolised to anti-inflammatory eicosanoids. |
| AA Arachidonic acid (20:4 n-6) (<i>cis</i> -5,8,11,14-eicosatetraenoic acid) | Precursor for the production of pro-inflammatory eicosanoids; some metabolic conversion from DGLA, but the main source of AA is the diet.; found in meat, fish and animal products. |
| Adrenic acid (22:4 n-6) (<i>cis</i> -7,10,13,16-docosatetraenoic acid) | Formed metabolically from elongation of arachidonic acid, one of the most abundant fatty acids in the early human brain |
| Eicosadienoic acid (20:2 n-6) (<i>cis</i> -11,14-eicosadienoic acid) | A minor omega-6 fatty acid, found in animal tissues. |
| Docosadienoic acid (22:2 n-6) (<i>cis</i> -13,16-docosadienoic acid) | A minor omega-6 fatty acid, found in animal tissues. |
| Omega-3 essential fatty acids | |
| ALA Alpha-linolenic acid (18:3 n-3) (<i>cis</i> -9,12,15-octadecatrienoic acid) | Essential fatty acid to which many health-beneficial effects are ascribed; dietary sources include seed oils (rapeseed, walnut, flax, hemp) and green leaves of some plants e.g. purslane (<i>Portulaca oleracea</i>). |
| ETA Eicosatetraenoic acid (20:4 n-3) (<i>cis</i> -8,11,14,17-eicosatetraenoic acid) | A minor omega-3 EFA, identified in New Zealand green-lipped mussel (<i>Perna canaliculus</i>), reported to act as an inhibitor of arachidonic acid oxygenation. |
| EPA Eicosapentaenoic acid (20:5 n-3) (<i>cis</i> -5,8,11,14,17-eicosapentaenoic acid) | Essential omega-3 fatty acid obtained in the human diet from oily fish that have consumed certain algae; found in human breast milk. Anti-inflammatory, precursor for prostglandin-3 (inhibits platelet aggregation), thromboxane-3 and leukotriene-5. |
| DHA Docosahexaenoic acid (22:6 n-3) (<i>cis</i> -4,7,10,13,16,19-docosahexaenoic acid) | Highest concentration omega-3 fatty acid in lipid membranes, primary structural component of the human brain and retina. Dietary source is oceanic fish, can be synthesised from EPA. Cardio-protective, lowers serum triglycerides. |
| Omega-5 fatty acids | |
| Myristoleic acid (14:1 n-5) (9-tetradecenoic acid) | Metabolically produced from myristic acid by the action of Δ -6 desaturase. In nature found in oil of nutmeg (<i>Myristica fragrans</i>). |
| Omega-7 fatty acids | |
| Palmitoleic acid (16:1 n-7) (9-hexadecenoic acid) | Present in all tissues, found in highest concentrations in the liver and adipose tissue. Synthesized from palmitic acid by the action of D-6 desaturase. Dietary sources include animal oils, vegetable oils and marine oils. Behaves like a saturated fatty acid in its effect of raising LDL cholesterol. May have a role in the control of body weight by affecting enzymes of fat oxidation pathways. |
| Cis-11-vaccenic acid (18:1 n-7) (11-octadecenoic acid) | Vaccenic acid was discovered in 1928 in butter and animal fats (<i>vacca</i> = cow). |

9 Weymouth Street, London, W1W 6DB. UK

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| | |
|--|---|
| Omega-9 fatty acids | |
| Oleic acid (18:1 n-9) (9-octadecenoic acid) | "Oleic" suggests derived from olives, but also produced metabolically. Has been used for the treatment of adrenoleukodystrophy, may have a hypotensive effect. |
| Cis-11-eicosanoic acid (20:1 n-9) | A mono-unsaturated omega-9 fatty acid, found in various plant oils |
| Mead acid (20:3 n-9) (cis-5,8,11-eicosatrienoic acid) | In severe omega-6 EFA deficiency, mammals will elongate and desaturate oleic acid to Mead acid. Normally present in significant amounts in cartilage. |
| Erucic acid (22:1 n-9) (cis-13-docosenoic acid) | In rapeseed, mustard seed, kale and other <i>Brassica</i> ; food grade rape seed oil (canola) is low erucic acid rapeseed (LEAR) oil |
| Nervonic acid (24:1 n-9) (cis-15-tetracosenoic acid) (selacholeic acid) | Has been identified as a requirement in the biosynthesis of nerve cell myelin and hence used in the treatment of disorders involving demyelination (e.g. multiple sclerosis). |
| Saturated fatty acids | |
| 12:0 Lauric acid (dodecanoic acid) | From coconut oil, palm oil and cinnamon; metabolized in humans to monolaurin, which has antimicrobial activity. |
| 14:0 Myristic acid (tetradecanoic acid) | Myristic acid is named after nutmeg (<i>Myristica fragrans</i>). Also found in palm oil, coconut oil and butter fat; a minor component of many other animal fats. |
| 15:0 Pentadecanoic acid (pentadecylic acid) | Major source is cows' milk butter fat; a marker for butterfat consumption. |
| 16:0 Palmitic acid (hexadecanoic acid) | One of the most common saturated fatty acids in animals and plants. A major component of the oil from palm trees (palm oil and coconut oil). Excess consumption of palmitic acid may increase serum cholesterol levels. |
| 17:0 Margaric acid (heptadecanoic acid) | Trace component of fat and milk fat of ruminants; not present in high concentration in any natural animal or vegetable fat. |
| 18:0 Stearic acid (octadecanoic acid) | The most common saturated fatty acid (with palmitic acid), more abundant in animal fat than vegetable fat, except for cocoa butter; consumption is said to lower serum cholesterol. |
| 20:0 Arachidic acid (eicosanoic acid) | Minor constituent of peanut and corn oil. |
| 21:0 Heneicosanoic acid (heneicosylic acid) | Found in human milk fat, HEA is also a part of the phospholipids of the articular cartilage boundary lubricant |
| 22:0 Behenic acid (docosanoic acid) | A major component of ben, or behen, oil from the tree <i>Moringa oleifera</i> . Also found in rapeseed and peanut oil. A cholesterol-raising saturated fatty acid in humans. |
| 24:0 Lignoceric acid (tetracosanoic acid) | Found in small amounts in most natural fats. |
| Trans-fatty acids | |
| <i>Trans</i> -11-vaccenic acid (18:1 n-7t) (<i>trans</i> -11-octadecaenoic) | A naturally occurring trans-fatty acid found in the fat of ruminants and in dairy products. |
| Elaidic acid (18:1 n-9t) (<i>trans</i> -9-octadecaenoic acid) | The major trans-fatty acid in hydrogenated vegetable oils. Atherogenic effect, increasing cholesteryl ester transfer protein (CETP), which in turn raises VLDL and lowers HDL. Abundant fatty acid present in atherosclerotic plaque. |

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