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An informative newsletter for the specialized clients of Doctor's Data, Inc.

The Science behind DDI's *new* Fatty Acids Analysis

by Chuck Masur, MD, Scientific Support Department

Fatty acids (FA) are monocarboxylic acids that have the general formula CnH2n+1COOH. They may be either ***saturated*** (no carbon-to-carbon double bonds; e.g. palmitic and stearic acids) or ***unsaturated*** (one or more carbon-to-carbon double bonds; e.g. eicosapentaenoic acid and docosahexaenoic acid). FAs either are absorbed during fat digestion or made in the body from other fats that are absorbed. They are a major source of substrate for the production of energy; during prolonged exercise they are the main nutrient mobilized from fat stores. Erythrocyte fatty acid analysis is superior to plasma fatty acid testing as erythrocyte FA levels better reflect long-term fatty acid intake because of less sensitivity to recent intake and a slower turnover rate (Qi Sun et al (2007), *American Journal of Clinical Nutrition* 86(1):74-81).

FAs may be as short as 4 carbons in length (e.g. butyric acid) but most fatty acids, at least those from natural sources (fats and oils), generally are at least 8 carbons in length (e.g. octanoic, or caprylic, acid) but may comprise chains of 4 to as many as 28 carbon atoms. FAs may be "short" (SCFA; less than 6 carbons), "medium" (MCFA; 6 to 12 carbons), "long" (LCFA; 12 to 22 carbons) or "very long chain fatty acids" (VLCFA; longer than 22 carbon atoms). This categorization generally holds true except in the case of essential fatty acids (EFA) where short-chain EFAs are 18 carbons long and long-chain EFAs are 20 or more carbons in length. FAs with more than one C=C double bond are referred to as ***polyunsaturated fatty acids*** (PUFA).

Fatty acid nomenclature varies but most readers will be familiar with the *omega*-x (ω–x) system which is correctly read as "*omega* (ω) minus x"—the first carbon-to-carbon double bond is at the xth position, counting from the terminal methyl. Linoleic acid [$CH_3(CH_2)4$**CH=CH**CH_2**CH=CH**$(CH_2)7COOH$] for example, is an omega-6 (ω-6) FA and, using the same convention, *alpha*-linolenic acid [CH_3CH_2**CH=CH**CH_2**CH=CH**CH_2**CH=CH**$(CH_2)7COOH$] is an *omega*-3 (ω-3) FA.

Saturated fatty acids have no carbon-to-carbon double bonds. For example, ***palmitic acid*** (16 carbons long and with no carbon-to-carbon double bonds; i.e. 16:0) is one of the most common saturated fatty acids found in animals and plants. It is the first fatty acid produced during fatty acid synthesis and can be used to make other longer chain fatty acids. Diets high in palmitic acid may be associated with increased risk of developing cardiovascular disease (this is somewhat controversial as palm oil also has a number of healthy attributes). ***Stearic acid*** (18:0) is another common saturated fatty acid that is found in many vegetable and animal fats and oils. It can be produced by processing animal fat in water under high temperature and pressure (e.g. pressure cooking produces stearic acid by the hydrolysis of triglycerides); and it can be produced by the hydrogenation of some unsaturated vegetable oils. Stearic acid can be oxidatively desaturated back to oleic acid, more readily so than the desaturation of palmitic acid back to palmitoleic acid), and thus may be "less unhealthy" than other saturated fatty acids.

Unsaturated fatty acids have at least one carbon-to-carbon double bonds—their carbon atoms are bound in either a

— continued on next page

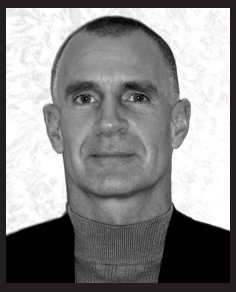
INSIDE

Meet Karen Urek, Vice President of Operations 3

Comprehensive Vaginosis Profile 3

Frequently Asked Questions 4

Scientific Support



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— *continued from page 1*

cis- (hydrogen atoms are on the same side of a carbon-to-carbon bond) or *trans-* (hydrogen atoms on opposite sides of the double bond) configuration. ***Cis- fatty acids*** (i.e. those FAs with one or more cis configurations) can be quite curved and are less flexible and are less able to be closely packed (as in membrane structures). ***Trans-fatty acids***, on the contrary, are relatively straight. Most *trans-* FAs (trans- fats) are not found in and are produced through human intervention by hydrogenation (processing) of unsaturated fatty acids. *Trans-* fats are found in margarines, fried foods, commercially prepared foods, baked goods and partially hydrogenated vegetable oils. Diets high in *trans-* fats may be associated with increased rick of coronary heart disease. Examples of unsaturated FAs include ***alpha-linolenic acid*** (18:3 ω–3), ***eicosapentaenoic acid*** (20:5 ω-3), ***docosahexaenoic acid*** (22:6 ω-3), ***arachidonic acid*** (20:4 ω-6), ***linoleic acid*** (18:2), and ***oleic acid*** (20:4 ω-6) —all are *cis-* unsaturated FAs.

Essential fatty acids (EFA) are FAs that cannot be synthesized within an organism and must be obtained from dietary sources. There are two families of EFAs: *omega*-3 and *omega*-6, all of which are polyunsaturated FAs (PUFA). Humans can produce all but two FAs (linoleic acid (18:2 ω-6) and *alpha*-linolenic acid (18:3 ω-3); both are widely found in plant oils and are the parent compounds of the ω-3 and ω-6 FA series. It is possible to convert one ω-3 FA to another ω-3 or one ω-6 to another ω-6 but no conversion from an ω-3 to an ω-6 (or visa versa) is possible nor is it possible to convert saturated fats into ω-3 or ω-6 unsaturated FAs.

SOME SAMPLE FATTY ACID RATIOS

Worst ω-6 to ω-3 Ratio	Poor Ratio	Better Ratio	Best Ratio
Sunflower – No ω-3	Cottonseed – almost no ω-3	Canola (rapeseed) oil 2:1	Flax seed oil 1:3
Peanut – No ω-3	Grapeseed – almost no ω-3	Olive 3:1 to 13:1	
	Corn 46:1	Soybean 7:1	

EFAs are used in the productions of hormone-like substances that regulate a wide range of functions including blood pressure, coagulation, lipid levels, immune response and inflammatory responses to injury and infection. Unfortunately, a typical Western diet may be high in ω-6 FAs but low in ω-3 FAs (e.g. EPA, DHA) and may be associated with depression and behavioral changes including violence. FAs play an important role in heart health as they provide the substrates for mechanical and electrical activity in cardiac tissue.

Free fatty acids (FFA) are FAs that are not bound, or attached in some fashion, to other molecules such as triglycerides or phospholipids. They are not water soluble therefore can only be transported within the circulatory system bound to albumin in plasma. FAs can be stored in fat cells (adipocytes) and, upon being released from adipocyte storage, can become FFAs. FFAs are utilized as substrate for energy (ATP) production. Heart and skeletal muscle energy production pathways prefer FFAs over glucose for ATP production; brain can't use FFAs so it depends on glucose or ketone bodies for fuel. Ketone bodies can be produced in the liver by metabolism of FAs.

Digestion and uptake of fatty acids is complex. SCFAs and MCFAs are absorbed directly via the intestinal capillaries and travel through the portal circulation; LCFAs are too large to be absorbed directly and but are absorbed through the lipid membranes of the cells of the microvilli, reassembled into triglycerides and then coated with cholesterol and protein—the complexes formed are called chylomicrons. Chylomicrons enter the lymphatic capillaries and travel via the thoracic duct into the left subclavian vein and are distributed directly from the heart throughout the circulatory tree without a first pass through the liver. Chylomicrons, eventually, are processed by the liver into very low density lipoproteins (VLDL) and low density and lipoproteins (LDL).

The standard American diet (SAD) is high in carbohydrates and, as grains are high in ω-6 and low in ω–3 FAs, the ratio of ω-6 to ω-3 FAs usually is higher than optimal. Oily fish, fish oils, wild game (i.e. not grain-fed), free-range beef and their dairy products as well as range-fed sheep and poultry all contain more prominent levels of ω-3 FAs. The microalgae *C cohnii* and *Schizochytrium sp.* are rich in ω-3 Docosahexaenoic acid (DHA) and, being non-animal in origin, the DHA produced in this fashion is acceptable to those on strict vegetarian diets. In a similar vein, the oil from brown alga (kelp) is high in ω-3 eicosapentaenoic acid (EPA).

The ω -6 to ω-3 ratio *(see chart above)* in dietary intake will ultimately influence the ratio of the ensuing eicosanoids such as prostaglandins, thromboxanes and leukotrienes. Clearly then, ω-3 and ω-6 fatty acids should be consumed in the appropriate proportions. Healthy ratios of ω-6 to ω-3 range from 1:1 to 1:4 while the ratios in the standard/typical western diet (SAD) may range from 10:1 to 30:1 (i.e. dramatically skewed toward ω-6 predominance.

The new ***Fatty Acids; Erythrocyte*** panel from DDI provides individual assessments of important saturated and unsaturated FAs and gives helpful commentary on these findings. In addition, the panel presents important FA ratios, provides information about their clinical importance and assists the clinician in making evidence-based decisions and more effective treatment plans for their patients. ■

Behind the Scenes at DDI— Meet Karen Urek, MT (ASCP), Vice President of Operations

Karen Urek joined Doctor's Data in 1992 to integrate her laboratory clinical background with the scientific expertise involved in laboratory testing. Karen received her B.S. in Medical Technology from the University of Illinois and is licensed by the American Society of Clinical Pathologists (ASCP). She worked 11 years as a technologist in hospital environments and 12 years in management roles at a large Blood Bank in the Chicago area. Karen was instrumental in assuring that DDI met regulatory requirements in order to be licensed by CLIA, OSHA, New York, California, Florida, and other states throughout the US.

During her 18 years at DDI, Karen has been directly involved with the day-to-day testing and the research & development of new testing. New advances in technology has greatly expanded and improved laboratory testing and Karen has been instrumental in promoting and in developing new tests. 15 new chemistry tests and an array of stool microbiology and parasitology testing have been introduced during this time. She has been associated with 6 publications and has given over 8 presentations on DDI testing. It is Karen's goal to maintain the highest quality of testing and to maximize the influence of the lab results on the management of patient's health.

Karen comments *"I have had the opportunity to work with George Hickok, the founder of DDI and many of the initial visionaries that challenged the direction of main stream medical practices. It has been inspiring to work in this arena where the emphasis is on prevention and health promotion. It has been disturbing to see the changes occurring in healthcare in this country, especially in regard to laboratory testing. Cost cutbacks and excessive regulatory oversight have stifled the utilization and development of a potential wealth of information that can be used to facilitate medical decisions and provide better patient care."* ■

What's New at DDI—

by Barb Berta, MS RD and David Quig, PhD

Comprehensive Vaginosis Profile *(optional at home specimen collection)*

Doctor's Data now offers a **COMPREHENSIVE VAGINOSIS PROFILE** which includes specimen collection materials that enable patients to obtain samples at home. Diagnosis of vaginal infections by symptoms alone, or self-diagnosis with use of over-the-counter products, are common practices but can result in misdiagnosis and treatment failure. The profile is utilized for the detection and identification of normal and pathogenic bacteria, yeast, *Trichomonas vaginalis* (pathogenic parasite) and other important cells (Gram stain, microscopic) that permit differentiation between bacterial vaginosis (BV) and vaginitis and aid in developing the most efficacious treatment protocols for positive patient outcome. A BV score is provided based upon a well established algorithm and, susceptibility testing is performed on all cultures of yeast and pathogenic bacteria providing botanical and pharmaceutical treatment options.

Symptoms of vaginitis may be responsible for 10% of all visits by women to their healthcare practitioners. Typical symptoms include vaginal discomfort, itching, burning, discolored malodorous discharge and sometimes pain. The major causes of infectious vaginitis are BV and vaginal yeast infections. Bacterial vaginosis is common and underestimated since data from the 2001-2002 and 2003-2004 NHANES indicate that about 30% of women of child bearing age were positive for BV and 50% of women with BV were asymptomatic. Although the exact causes of BV and vulvovaginal candidiasis are not clear, a likely factor is change in the normal vaginal microbiota *(Lactobacilli)* resulting in proliferation of harmful bacteria or yeast. The balance of microflora may be disrupted by any combination of poor diet, poor hygiene, and overuse of antibiotics or corticosteroids, abnormal menstrual flow, use of oral contraceptives, pregnancy, sexual contact, douching, and use of perfumed hygiene products or an intrauterine contraceptive device. Potential complications associated with BV include upper genital urinary tract infections, preterm delivery, postoperative pelvic infections and increased susceptibility to sexually transmitted diseases (including Trichomoniasis).

The option of at home specimen collection with the DDI Comprehensive Vaginosis Profile will facilitate accurate diagnosis of the causes of the symptoms of vaginitis and permit appropriate targeted therapy. ■

Q&A

Frequently Asked Questions

> The Urine Iodine test is an excellent way to assess for Iodine sufficiency but how do I make sure I collect the sample properly?
. . . JB, Irvine CA

Barb Berta MS, RD responds:
There are five pointers that are most important to insure proper sampling for the urine Iodine test:

1. Avoidance of all Iodine supplements 24 hours prior to and during the test

2. Collecting the urine for a full 24 hours without producing more urine that the 3000 ml jug

3. Correctly reading the 24 hour volume

4. Accurately recording the full 24 hour urine volume on the requisition form

5. Mixing the container well before pouring the sample into the collection vial. ■

> I'm a new client and I have some general questions about some of your tests, some test protocol questions, and also some questions about the results of a test that I ordered recently. What is the process and who do I speak with to get these questions addressed?
. . . ML, Edmonton, Canada

Chuck Masur MD responds:
For your general questions you might first refer to our web site at **www.doctorsdata**.com. Clicking on the Tests/Assessments Info tab will present you with our menu of Nutritional, Gastrointestinal and Environmental analyses. Clicking on a particular menus item will give you a detailed explanation of that test and offer you a clickable link to a pdf picture of a sample report. If you need further assistance, our Customer Service department is available at (800) 323-2784 from 8:00AM until 6:00PM central time Monday through Friday. These are the first people that you should speak with as they can provide answers to most commonly asked questions. If you would like to discuss the results of a particular test in detail, or have questions about testing protocols, methodology or technology you can ask to be put through to the Scientific Support Department. Alternatively, you can request to speak directly with David Quig, PhD (VP Scientific Support), Chuck Masur, MD or Barb Berta, MS RD. If it would be more convenient, you can book telephone appointments with any of the Scientific Support personnel for detailed and/or lengthy consultations. ■

> IMPORTANT NOTE

The importance of rotating your kit stock

Beginning in May 2009, we began placing expiration dates on each of our test kits to help your staff quickly identify if the kit you are providing to your patient is still valid for testing. It is important to check these dates before handing out a kit as some of the preservatives used inside the kits may no longer be viable once the date passes, particularly for our gastrointestinal profiles. Samples that arrive at our laboratory after the expiration date has lapsed may not be valid for testing and could result in the need for your patient to recollect another specimen. Please feel free to contact Customer Service at any time if you believe that your kits may soon be out of date. We will be more than happy to either provide you with new kits, or send you replacement materials for just those items approaching expiration. ■

We appreciate your continued interest and urge you to contact us should you have any questions. Our Customer Service Department is available between 8:00 and 6:00 CST Monday through Friday.

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