



Lyman S. Stanton
800 Las Trampas Road
Lafayette, CA 94549

Dear Mr. Stanton:

I am responding to your letter to the Office of Nutritional Products, Labeling, and Dietary Supplements in the Center for Food Safety and Applied Nutrition. You express confusion about the labeling of dietary fat. In particular, you ask why the sum of the three fatty acids (i.e., saturated, monounsaturated, polyunsaturated) listed in the Nutrition Facts of the margarine that you use is less than the amount listed for "Total Fat."

As we discussed in our conversation of March 21, the monounsaturated and polyunsaturated fatty acids listed in Nutrition Facts are fatty acids having double bonds in a *cis*-configuration. Fatty acids having double bonds in a *trans*-configuration are not listed. For this reason, the sum of the fatty acids listed on your margarine label is not equal to the amount listed for "Total Fat."

As I also mentioned to you, the Food and Drug Administration has proposed to require that *trans* fatty acids be listed in "Nutrition Facts" (64 FR 62746, November 17, 1999). I will forward your letter as a comment to the docket on this rulemaking. We are hoping that the final rule is published in the near future.

Thank you for your letter. Please call me at 301- 436-1784 if you have more questions.

Sincerely yours,

Susan Thompson

Susan Thompson, Ph.D.
Chemist
Division of Nutrition Labeling and Programs
Office of Nutritional Products, Labeling
and Dietary Supplements
Center for Food Safety
and Applied Nutrition

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C 2608 / ANS

800 Las Trampas Road
Lafayette, CA 94549
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925-283-1908
lymanstantonhome@juno.com

ONPLDS HFSB10
Harvey W. Wiley Federal Office Building
5100 Paint Brush Parkway
College Park, MD 20740

Subject, Dietary Fats Labeling,

1. Summary

It has been observed that the labeling of dietary fats on packaged food reports partially hydrogenated vegetable oils under the Total Fat but omits the same under Saturated Fat, Polyunsaturated Fat and Monounsaturated Fat. It is suggested that partially hydrogenated vegetable oils be included with the other sources of dietary fat using the same fat classifications. It is suggested that the term "trans fat" not be used because its composition is indeterminate. It is suggested that if a fourth classification of dietary fats is to be added, omega 3 fat be added. The bases of these suggestions are given below.

2. Labeling

I have noticed and read that the amounts of saturated, monounsaturated and polyunsaturated fat on labels do not at times add to the total fat. The label on the margarine "I Can't Believe It's Not Butter", made by Lipton, reads: "Total Fat 10g, Saturated Fat 2g, Polyunsaturated Fat 2g, and Monounsaturated Fat 2.5g" in a standard serving. This adds to 6.5g. What happened to the other 3.5g? I contacted two distributors who had similar labels and they did not have an answer! A bottle of olive oil from Italy records: Total Fat 14g, Saturated Fat 2g, Polyunsaturated Fat 2g and Monounsaturated Fat 10g, which adds to 14g, showing that including all the fat can be done. Also some labels list only Total Fat and Saturated Fat. Has all the Saturated Fat been included? There is no way of knowing.

An article in the Wall Street Journal, 12/27/03, page B1, answered the question. Partially hydrogenated vegetable oils, called "trans fat", are being omitted from the fat classifications based on degree of unsaturation. The reason given is: "But trans fats chemically aren't the same as saturated fats so combining them is not technically correct." True, but not applicable. This statement also applies to all the dietary fats listed below. All of these fats are mixtures of fats with different amounts of unsaturation, while saturated fats are only saturated fats.

3. Dietary Fat Chemistry

Dietary fats usually consist of three fatty acid molecules chemically bonded to a glycerin molecule. The fatty acids consist of chains of carbon atoms of several lengths, usually 18 or 16 carbon atoms, with two hydrogen atoms bonded to most carbons and a carboxylic acid group at the end bonded to glycerin. One hydrogen atom can be removed from each of two adjacent carbon atoms, and the bonds freed connected together between the carbon atoms to form a double carbon bond.

Dietary Fats Labeling, continued

3. Dietary Fat Chemistry, continued

Fatty acid chains containing no double carbon bonds are called saturated because no more hydrogen can be added. A fatty acid chain containing one double carbon bond is called monounsaturated because two hydrogen atoms can be added. In dietary fat labeling the term polyunsaturated is used to designate a fatty acid chain containing two or three double carbon bonds where additional hydrogen can be added. Since all the dietary fats listed below are mixtures of fatty acids containing double carbon bonds and saturated fatty acids, they are all partially hydrogenated.

Double carbon bonds occur in two different forms, a zigzag form called trans or a bent form called cis. I could not find any information on which forms occur in natural dietary fats. Saturated fats do not have cis and trans forms because they have no double bonds. Completely hydrogenating an unsaturated fat destroys all cis and/or trans fat. The carbon chains in saturated fats are straight and pack together better, which raises the melting point and often makes saturated fats solids at room temperature. It can lead to confusion if "trans fat" is used to name a type of partially hydrogenated dietary fat.

4. Common Dietary Fats

The compositions of common dietary fats are listed in the table below in the order of increasing saturated fat. To save space the fatty acid chains are classified by the number of double carbon bonds. Concentrations are given in weight percent. Source: Calgene Annual Report 1988, page 11.

Labeling	Sat	Mono	Poly	
Number of double bonds	0	1	2	3
Canola oil	6	58	26	10
Safflower oil	9	13	78	tr
Sunflower oil	11	20	69	0
Corn oil	13	25	61	1
Olive oil	14	77	8	1
Soybean oil	15	24	54	7
Peanut oil	18	48	34	0
Cottonseed oil	27	19	54	0
Lard	41	47	11	1
Palm oil	51	39	10	0
Beef tallow	52	44	3	1
Butterfat	66	30	2	2
Coconut oil	92	6	2	0

The information on specific fatty acids in dietary fats I could find is summarized below. The saturated fatty acids, 18 carbon stearic acid and 16 carbon palmitic acid, appear in lard, beef tallow, and butterfat. Butterfat is unusual by containing eight different saturated fatty acids, with even numbers 4 thru 18 carbons. Olive oil and cottonseed oil contain the 18 carbon oleic acid which has one double carbon bond. All the dietary fats listed above contain the 18 carbon linoleic acid which has two double bonds. The fatty acid with three double bonds in the table above is the 18 carbon alpha-linolenic (or omega 3) acid.

Dietary Fats Labeling, continued

5. Hydrogenation

Hydrogen can be added chemically to the double carbon bonds in the unsaturated dietary fats listed above in a process called hydrogenation. As hydrogenation proceeds it goes stepwise, one double carbon bond at a time, until the saturated fat is reached. Hydrogenation then stops. The number of carbon atoms in the chains does not change.

The term "partially hydrogenated" is indeterminate because it does not say how far hydrogenation has gone. It does not tell the astute consumer that his food has been altered, by adding an unstated amount of unhealthy saturated fat.

The commercial reason for hydrogenating vegetable oils is to get low cost saturated fat. Hydrogenation has to be stopped when the desired saturated fat level is reached and the extent of double carbon bonds remaining determined. Alternatively a portion of the fat may be totally hydrogenated and then blended to obtain the desired concentration.

It should be mentioned that the various fatty acids are chemical compounds and that their composition is independent of how they were made or the history of how they got into food. Stearic acid is the same from a vegetable oil, butterfat, hydrogenation of an unsaturated vegetable oil, or from a pig.

6. Nutrition

Saturated fat is supposed to be bad for people. An article in "Scientific American", Jan 2003, page 68, compares a population in Finland that got 38% of its calories from butterfat with a population in Crete that got 40% of its calories from olive oil. From the table above butterfat is 66% and olive oil 14% saturated fat. With butterfat the annual incidence of heart disease per 100,000 men was 3,000 and with olive oil 200. If this was entirely due to saturated fat an incidence of 636 would be expected for olive oil. Something else is involved.

Canola oil is also supposed to be good for people. At 6% it is the lowest in saturated fat. Olive oil is the lowest and canola oil the second lowest in the sum of saturated plus doubleunsaturated fats. The table above shows that butterfat and canola oil have the highest levels of fat containing one double carbon bond. Omega 3 fat, 3 double bonds, is suppose to be good for people. It would follow that fats with 0 or 2 double carbon bonds are bad for people and fats with 1 or 3 double carbon bonds are good for people.

It follows that consumers need to know the amounts of the above four levels of saturation in the fats they purchase. Leaving out the fats in partially hydrogenated vegetable oils can be considered a fraud and at best is misrepresentation. All dietary fats and their levels of unsaturation should be included. This should be a simple thing to do.

Yours truly,



Lyman S. Stanton
Chemical Engineer