Fat Digestion, Absorption and Transportation
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Hello section 1 of Nutrition 251. My name is Danyelle Meleta and I am one of your TA’s. Because class was cancelled, Ms.Kelly asked me to write up a review of the material that would have been covered in class. The topic is lipids (fats) and more specifically, the absorption and digestion of those fats within the body. This information and more details can be found in Chapter 5 of the textbook *Understanding Nutrition*.

**Introduction:**
Lipids are a type of essential macronutrient, which means they must be consumed in the diet because the body cannot synthesize them on its own. Fat is a type of lipid that is solid at room temperature and, after digestion, is broken down into fatty acids within the body by the processes of digestion, absorption, and transportation. Fatty acids have an acid group at one end and a methyl group at the other end, as shown in Figure 1. Fatty acids are rarely free within foods or the body and frequently, they serve as parts of triglycerides (the chief form of fat in the diet and major storage form of fat in the body). A triglyceride is a molecule of glycerol with 3 fatty acids attached, which is shown in Figure 2.

![Fatty Acid Molecule](Image from Understanding Nutrition)

![Triglyceride Molecule](Image from Understanding Nutrition)
Background Knowledge:
Consisting of carbon chains that can be up to 24 carbons in length, and providing 9 kilocalories per gram of energy, fat can take on a few different forms within the foods we eat. There are saturated fats, monounsaturated fats, and polyunsaturated fats. The saturated fats consist of only single bonds.

A polyunsaturated fat can be characterized further into a linoleic or linolenic acid. A linoleic acid, also referred to as an omega-6 fatty acid, occurs when the first double bond is 6 carbons out from the methyl carbon. Good sources of these omega-6 fatty acids include leafy vegetables, grains, nuts, seeds, and vegetable oils. On the other hand, a linolenic acid, also referred to as an omega-3 fatty acid, occurs when the first double bond is 3 carbons out from the methyl carbon. These fatty acids can be found in food such as canola, soybean, flaxseed, and wheat germ. Both linoleic and linolenic acids act as precursors to other fatty acids.
Digestion:

First fat must be digested in the body. Digestion is the process by which food is broken down into absorbable units, and is described in Figure 4. According to Whitney, the goal of fat digestion is to dismantle triglycerides into small molecules that can be absorbed and used by the body, or namely monoglycerides, fatty acids, and glycerol. Although most of fat digestion occurs in the small intestine, it begins in the mouth. Some digestion also occurs in the stomach where solid pieces are ground into smaller particles. Then the fat moves down to the small intestine where the majority of the fat digestion occurs.

Absorption:

The next step fat goes through in the body is absorption, or the uptake of nutrients by the cells of the small intestine for transport into either the blood or lymph. Once the fat reaches the small intestine, Cholecystokinin (CCK), a hormone, releases bile, which then helps emulsify the fat. This produces small particles called micelles. The micelles are then absorbed into the intestinal cells where they reform into triglycerides and phospholipids.
Phospholipids play a big role in this absorption process. They are similar compounds to triglycerides, except they have a phosphorylated alcohol in place of one fatty acid chain like the image shown in Figure 5. The phosphate group is hydrophilic, meaning it is water-soluble, or polar. The fatty acids, on the other hand, are hydrophobic, meaning they are water-insoluble, or non-polar. Thus, phospholipids are both hydrophilic and hydrophobic. This allows them to help fat-soluble substances pass easily in and out of cells. Another role of the phospholipids is acting as emulsifiers in the body, and thus helping fats to stay suspended in the blood and body fluids.

**Transportation:**

Finally, once the fat is absorbed into the blood or lymphatic system, it then must be transported to different parts of the body. This is done with the help of lipoproteins. Lipoproteins are collections of lipids and proteins, shown in Figure 6, that act as transport vehicles for lipids in the lymph and blood. More specifically, chylomicrons are the lipoproteins in charge of transporting the lipids from the

**Figure 5: Phospholipid molecule**

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**Figure 6: Lipoprotein structure**

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intestinal cells to the rest of the body.

Also, the liver repackages lipids into other types of lipoproteins for distribution in the body, namely VLDL and HDL. VLDL stands for very-low-density lipoprotein and it is in charge of moving lipids to different tissues throughout the body. HDL, on the other hand, stands for high-density lipoprotein, which moves cholesterol back to the liver from the cells. Cholesterol is a type of lipid that relates closely to the risk of cardiovascular disease (CVD), which is any disease that refers to the heart and blood vessels.

**Health Implications:**
The process of fats throughout the body, namely digestion, absorption, and transportation, allow for better understanding of the health risks that are caused from fat. Consuming too much of the wrong types of fats provides for a larger risk of developing cardiovascular disease. Also, consuming too much dietary cholesterol can lead to these diseases, as well. The main causes for CVD are obesity, high dietary fat, high dietary cholesterol, and saturated fatty acids. Thus, to reduce your risk of CVD, you should consume more monounsaturated fat and polyunsaturated fat. Good sources of these include olive oil, canola oil, avocados, vegetable oils, nuts, and seeds. The best way to reduce your risk is just to maintain a healthy body weight and participate in physical activity.

**Conclusion:**
Once fat is consumed, it must be digested, absorbed, and lastly transported. The fat gets broken down into smaller units, made into micelles that are then absorbed into the cells with the help of phospholipids, and then it is transported through the blood or lymph system to various parts of the body, by the help of lipoproteins. The importance of this process is being aware of the risks of consuming too much fat. Cardiovascular diseases are very common with people who are overweight and consume too much cholesterol. Ultimately, to lower the risk for developing CVD, you should, first and foremost, maintain a healthy body weight and participate in physical activity. It also would help to include variety, balance, and moderation within the foods that you eat.

**Works Cited:**