The Kashrut of Mono- and Di-Glycerides

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SHE'ELAH

Are food products containing mono- and di-glycerides kosher?

TESHUVAH

Mono- and di-glycerides (MDG) are manufactured from fat and oils which may be of vegetable origin or animal origin. The question we must answer is whether we must ascertain whether the MDG is of vegetable origin and therefore kosher and parve, or whether MDG of any origin can be considered a chemical and not a food. If it is to be considered a chemical, can a chemical whose origin may be from an originally forbidden food lose its forbidden character and be accepted as kosher? In addition, how does any remaining original fat (tri-glycerides) affect the status of the food product?

Food chemistry is an extremely complicated science, and it is necessary to consult experts in the field to obtain the technical information basic to an informed decision. I therefore wrote to Dr. Marvin Steinberg, who is Professor of Food Engineering at the University of Illinois at Urbana-Champaign and whom I asked a number of questions regarding MDG. He graciously agreed to answer my questions and his answers follow.

What is the process for the manufacture of mono- and di-glycerides?

(1) The fat, sometimes partially hydrogenated oil, is mixed with glycerol in a ratio of 20 pounds glycerol to 100 pounds fat.
(2) To this is added a small amount, about 1%, caustic soda (sodium hydroxide). This is heated to about 450°F for about two hours to carry out the chemical reaction; the sodium hydroxide saponifies a small amount of fat to soap which acts as a catalyst to glycerinate the fat. This means that the fatty acid chains of the original oil redistribute themselves, i.e., some move from the tri-glyceride to the glycerine to form mono-glycerides (glycerine with one fatty acid chain) and di-glycerides (glycerine with two fatty acid chains).
(3) Then the mixture is cooled to 200°F and an excess of concentrated phosphoric acid is added to decompose the soap formed back to the original fatty acids and sodium phosphate, which is insoluble and is filtered out. The resulting mixture is about 50% mono-glyceride and contains in addition di- and tri-glycerides, some free glycerol, and some free fatty acids. Some of the tri-glyceride is original fat.
(4) This product may be added to foods as is or it may be distilled, i.e., heated to high temperature under strong vacuum with the vapors, which are about 90% mono-glyceride, condensed to obtain a more active (and more expensive) liquid or solid product.

Glycerol is a major constituent added in the manufacturing process. What is it and would it present any problems from the standpoint of kashrut?

Glycerol (also called glycerine) is an alcohol. It has three hydroxyl groups, whereas propylene glycol, commonly used in flavors, has two, and ethyl alcohol, found in wine, beer and whisky, has only one. Glycerol is a chemical commonly obtained as a by-product from soap manufacture. It is obtained very pure so it should not present any more problem than any other chemical such as vinegar.

In the process of manufacture, is there a stage when the tri-glycerides would be totally inedible?

My answer is a definite yes, not only in one stage, but in every stage. At stage 1, the 20% glycerol would make the tri-glyceride extremely bitter and mouth-drying. At stage 2, before heating, we have the presence of caustic

soda. This could dissolve tissue in the mouth and cause pain. After heating, we have the presence of soap and everyone knows how bad that tastes. At stage 3, the presence of concentrated phosphoric acid would make the mixture inedible. To complete this assessment, I tasted a finished product used in my lab (Atmos 150) and had to spit it out; it was soapy, greasy and had a mouth-drying effect.

Do the tri-glycerides that go through the manufacturing process differ in any way from the naturally occuring tri-glycerides?

This has not been tested, so my answer is based on a related process. In this process, the fat is saponified as above and then the fatty acids are allowed to react with the original glycerol, i.e., no glycerol is added. The result is a rearrangement of the fatty acids on the glycerol so that an outside chain is now a middle chain. This changes the physical properties. Thus, I am confident that a large portion of the remaining tri-glyceride has been altered; I would estimate about 2/3.

What are the purposes for which mono- and di-glycerides are used in food products?

They are used as emulsifiers, i.e., surface active agents. This means they position themselves between the fat phase and the aqueous phase and that explains why a tiny amount goes so far. In practical terms, they keep fat or oil from separating out. A good example is salad dressings; the kind that shows an oil layer and must be shaken before use does not contain an emulsifier while the ready-to-pour does. A great many other processed foods require addition of this emulsifier to obtain good quality and shelf-life; ice cream and cake mixes are but two examples.

What is the percentage of tri-glycerides in comparison to mono- and di-glycerides?

The non-distilled product contains 3% tri-glyceride and the distilled product contains 1% tri-glyceride. The remainder in each case would be mono-glyceride and di-glyceride (45 and 90% respectively).

What would be the percentage of tri-glycerides in food products, in a worst case scenario?

According to a scientist at Eastman Chemical Products Company, Rochester, New York, the major producer of this emulsifier, the largest amount of this product added to a food is 2% on a fat basis and the maximum content of tri-glyceride is 3%. Then assume one-third of this is unchanged and that the food contains 10% fat. The calculation becomes as follows, producing a resultant which is only 2 parts in 100,000:

$$\frac{2 \text{ g emul.}}{100 \text{ g fat}} \times \frac{3 \text{ g trigl.}}{100 \text{ g emul.}} \times \frac{1 \text{ g unch. trigl.}}{3 \text{ g trigl.}} \times \frac{10 \text{ g fat}}{100 \text{ g food}} = 0.002\%$$

Do mono- and di-glycerides serve as a coagulant as well as emulsifier? Do the tri-glycerides serve as emulsifiers?

No, the mono- and di-glycerides cannot coagulate a food. Just the opposite is true; they serve to maintain an oil-in-water emulsion while a coagulent such as rennet serves to break the protein-in-water emulsion into solid (cheese) and liquid (whey) components.

A tri-glyceride cannot act as an emulsifier. Only molecules containing alcohol units in place of one or two of the three fatty acid chains (i.e., mono- and di-glycerides) can act as emulsifiers.

CONCLUSIONS

From the information provided by Dr. Marvin Steinberg, we see that mono- and di-glycerides are manufactured by a chemical reaction from original tri-glycerides. However, up to three percent tri-glycerides may remain in the resultant mixture of mono- and di-glycerides. The process of manufacturing involves the use of caustic soda and phosphoric acid and renders the mixture inedible at several stages in the process. The end product, MDG, is not a food, but an emulsifier which keeps fats and oil suspended in an aqueous mixture. The maximum amount of original tri-glyceride (i.e., non-kosher fat) which can be found in a food product is only two parts in one hundred thousand.

Dr. Isaac Klein, in his responsa on "The Kashrut of Gelatin" (1969)[1] and "The Kashrut of Cheeses" (1970)[2] analyzes a number of principles which have wide application to all questions regarding the kashrut of chemical

food additives. His analyses should be consulted for details. Of particular interest is the term *davar ḥadash, panim ḥadashot*. Dr. Klein says "the term *davar ḥadash, panim ḥadashot* used by Rabbi Hayyim Ozer Grodzinsky reflects an important principle: when a substance goes through a transformation that changes it into something completely new, it also loses its former status in regard to being a forbidden food."[3] Based on this principle, Rabbi Klein draws the conclusion that "a substance treated by another substance which transforms it chemically thus becomes a *panim ḥadashot*".[4] Mono- and di-glycerides are a manufactured chemical and are therefore considered in the category of *davar ḥadash, panim ḥadashot*, and can be considered both kosher and parve.

There is another question that must be dealt with and that is the effect that the up to three percent of tri-glycerides which may remain in the MDG mixture has on the food product. The tri-glycerides are not in the category of *davar hama'amid afilu be'elef lo batel* (a coagulant is not neutralized even by a thousand times its bulk), for the physical reaction of coagulation (congealing) is different from emulsification (suspension of oil in an aqueous solution). Secondly, the emulsifying agent is the MDG and not the tri-glycerides, which are an incidental and unwanted substance. In addition, Dr. Klein cites the opinion of Rabbi Yehudah Leib Graubart that the principle of *davar hama'amid afilu be'elef lo batel* "applies only in the case of an edible food, but not where the coagulant has ceased to be a food."[5]

If we accept the premise that tri-glycerides are not a *davar hama'amid*, but a food, then it should be noted that the tri-glycerides have passed through several stages in the process of manufacture where they had been treated with caustic soda and phosphoric acid (*noten ta'am lifgam*), and lost the status of food (*nifsal me'akhilat kelev*). In addition, since the tri-glycerides would constitute only two parts in one hundred thousand in a food product, they are certainly *batel beshishim*.

Mono- and di-glycerides, whatever their origin, are kosher and parve.

NOTES

1. Isaac Klein, "The Kashrut of Gelatin," *Responsa and Halakhic Studies* (KTAV Publishing House, 1975), pp. 59-74.
2. Isaac Klein, "Kashrut," *Responsa and Halakhic Studies* (KTAV Publishing House, 1975), pp. 43-58.
3. Isaac Klein, "The Kashrut of Gelatin," p. 71.
4. Isaac Klein, "The Kashrut of Gelatin," p. 72.
5. Isaac Klein, "Kashrut," p. 56.