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Over the years, I have been invited on multiple occasions to speak at various girls' high schools in Lakewood about the impact of astronomy on the Jewish calendar and halachic *zmanim*. The inherent message I have aimed to give over is that one needs a basic understanding of math and science to fully comprehend certain halachic issues.

For example, the earth's rotation on its axis is the basis of *zmanei hayom* (halachic times of the day) that are so much a part of our lives with regard to davening times and knowing when Shabbos and Yom Tov begin and end. One needs to know how the moon rotates around the earth to better understand Rosh Chodesh and the Jewish calendar. Indeed, Chazal had keen insights into scientific topics that were discovered hundreds of years later by researchers.

Investigating how a product is manufactured and analyzing the composition of the raw materials used in the process is critical to determining whether a product can be certified kosher. Principles of biology, chemistry and physics play a fundamental role in food production.

During recent factory inspections, I began to track several examples of how each of these disciplines intersects with kashrus.

BIOLOGY

Many food products are produced through fermentation. These include *whiskey*, in which yeast is used to convert the sugars in grains into ethanol, and which must be carefully tracked to ensure that no grape derivatives were used which could render the product non-kosher[1]; *citric acid*, an ingredient commonly found in soft drinks; and *amino acids*, including L-arginine and L-methionine, which are staple ingredients in many productions and require the use of kosher certified growth media and other ingredients.

As a STAR-K kashrus administrator, I recently had a unique opportunity to review the production of penicillin in a factory that manufactures thousands of tons of this antibiotic each year. Penicillium fungus, better known as mold, was being grown in large fermenters where it was "fed" glucose and lactose. This growth media has important halachic ramifications: one of the sources of the glucose used in this plant is wheat (the other being corn) and lactose (milk sugar) – rendering the finished product both *dairy* and, possibly, *chometz*.

The production process concluded with the introduction of an acid that caused the mold to release *penicillin*, a self-defense antibiotic

1. For a detailed explanation, see "Kashrus in High Spirits" by Rabbi Tzvi Rosen at https://www.star-k.org/articles/kashrus-kurrents/1139/kashrus-in-high-spirits/.

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Vinegar:
Doing Kashrus Tastefully

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Vinegar has a long and storied history and plays a highly-prized role in every aspect of modern life – whether as a nutrient, flavorant, preservative or household cleanser. The name *vinegar* is derived from the French "*vin aigre*, which literally means sour wine. According to legend, its discovery is credited to a neglected barrel of wine that had been left in storage and allowed to ferment and become sour.

We find several references to vinegar in both Tanach and the Gemara. A *nazir* is forbidden to consume anything derived from grapes, which includes wine vinegar;[1] Dovid Hamelech accuses his tormentors metaphorically of giving him vinegar to quench his thirst;[2] Boaz's workers dip their bread in vinegar;[3] and Mar Ukva refers to himself as "Chometz ben Yayin" – Vinegar, the son of Wine – when comparing himself to his father's degree of piety.[4]

Vinegar Production

In Hebrew, the term for vinegar, *chometz*, shares a root with the word for leavened products, *chametz*, underscoring the connection between the production of vinegar and the leavening of bread.

Vinegar production involves three basic processes: two stages of fermentation, followed by one of filtration.

❶ *Alcoholic fermentation:* In this first stage, a sugary or starchy liquid (e.g., fruit juice, wine or beer) is fermented into alcohol by yeast, a fungus found in nature.

1. Bamidbar 6:3.
2. Tehillim 69:22.
3. Rus 2:4.
4. *Chullin* 105a.

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THE MITZVAH OF

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We are an *Am Kadosh*, a Holy People, who are mandated by Hashem to imbue all aspects of our lives with holiness. We elevate even the mundane activity of eating and vest it with special *kedusha* (sanctity): the food on our plates must be kosher and the table on which we eat is likened to the holy *mizbe'ach*. The plates themselves, and all *keilim* (vessels and utensils) used to prepare our food, must likewise be infused with *kedusha*.

Just as an *aino Yehudi* must *tovel* in a mikvah in order to become Jewish, so too must *keilim* acquired from an *aino Yehudi* undergo *tevila* in a mikvah before being used by a Jew. This is the mitzva of *tevilas keilim*.

If a *kli* requires *tevila*, it may not be used even once before it is *toveled*. If a *kli* was used numerous times without *tevila*, one is still required to immerse it before its next use. *Keilim* may require either *tevila* with a *bracha*, *tevila* without a *bracha*, or no *tevila* at all – depending on what material they are made of and what their intended use is.

Keilim Requiring Tevila With a Bracha

- Metal or glass *keilim* which have direct contact with food during preparation or during the meal
  - *Metals* include: gold, silver, iron, copper, lead, tin, brass, bronze, stainless steel and aluminum
  - *Glass* includes: Pyrex and Corelle dishes

Keilim Requiring Tevila Without a Bracha

- *Keilim* made from glazed china, glazed ceramic, glazed stoneware or porcelain
- Dutch ovens, Corningware and Teflon-coated metal pans
- Metal and glass containers when used only for food storage and not brought to the table
- Disposable aluminum pans which will be used only one time
- If there is a doubt whether a *kli* was already *toveled*

Keilim That Do Not Require Tevila

- *Keilim* made from unglazed ceramic, unglazed stoneware, wood or plastic
- *Keilim* that do not come into direct contact with food (e.g., a corkscrew, can opener, the heated base of a crockpot)
- Ordinary glass container of a food item that was bought and emptied by a Jew (e.g., a juice bottle or jam jar)
- *Keilim* made by a Jewish craftsman (whether Shomer Shabbos or not) for a Jewish-owned company and sold directly to a Jewish customer.
- *Keilim* used exclusively with raw, non-edible food (e.g., a metal meat tenderizer)
- *Keilim* not manufactured for food usage and used only occasionally in food preparation (e.g., an arts and crafts knife)

Who May Tovel

Anyone may *tovel keilim*, including a small child or an *aino Yehudi*. The *tevila* must be done in the presence of a Jewish adult to verify that it was performed correctly. The recitation of a *bracha* can only be said if an adult Jew does the immersion. If many *keilim* are to be immersed with the help of a child or an *aino Yehudi*, the Jewish adult should initiate the *tevila* process by immersing a *kli* with a *bracha*, after which the child or *aino Yehudi* can take over.

Where to Tovel

The immersion must be done in a mikvah that is kosher for *tevilas nashim*. One may also *tovel* in the ocean. Natural rivers that rise due to rain or melting snow may be used only after they settle back to their normal level. A competent halachic authority should be consulted before using a lake or pond, as they may be used for *tevilas keilim* only when they meet certain halachic criteria.

When to Tovel

Tevilas keilim may be performed during the day or night, except on Shabbos or Yom Tov. In case of necessity, if one needs to use a *non-toveled kli* on Shabbos or Yom Tov, it should be given to an *aino Yehudi* as a gift and the Jew should borrow it back. After Shabbos, if the Jew re-purchased the *kli* from the *aino Yehudi*, it requires *tevila* with a *bracha*. If the Jew continues to use the *kli* without re-purchasing it, it will require *tevila* without a *bracha*.

How to Tovel

The *kli* to be immersed must be completely clean – free of dirt, dust, rust, stickers, labels or glue. If the *kli* was *toveled* with a label, a rabbinic authority should be consulted. If the label is intended to stay on permanently, such as a warning label, one is not required to remove it before *tevila*.

If a *bracha* is required on multiple *keilim*, one wets his or her hand in the mikvah water prior to the immersion, holds one of the *keilim* in the wet hand, says *"Baruch….al tevilas keilim,"* and immerses the *kli*; the remaining *keilim* are then *toveled* without another *bracha*. If only one *kli* is being immersed, the *bracha* is *"al tevilas keili"* (in the singular).

The entire *kli* must be submerged in the mikvah water at one time. Care must be taken that *keilim* being *toveled* are not touching each other in a way that would prevent water from getting in between them. One must ensure that there are no air bubbles trapped in the *kli*, as they would prevent water from touching the entire *kli*. For this reason, a narrow-necked bottle should be *toveled* neck-up so that the inside of the bottle will fill completely with mikvah water. Similarly, a pocket-knife used for food should be *toveled* in its open position so that the water will touch all areas of the blade. Equipment made of multiple components that are assembled as a single unit should be *toveled* in the manner used and not piece by piece.

An electric appliance that will certainly be ruined if *toveled* may be used without *tevila*, as it is impossible to fulfill the mitzvah. One can

TEVILAS KEILIM

assume that an appliance with a digital display or a computer chip will be ruined if *toveled*. For this reason, a Keurig machine may be used without *tevila* (see Sidebar).

An electric appliance which likely will survive the *tevila* process should be *toveled* (though there is no guarantee it won't be damaged). Simple electric devices generally fall into this category. After *tevila*, it is important to let the appliance dry very well – for at least three days – before using it, as it is more likely to short-circuit if it is damp.

Ownership Issues Affecting Tevila

A purchased *kli* requires *tevila* if the manufacturing company is owned by an *aino Yehudi*, even if all the workers are Jewish. Unless one has information to the contrary, one should assume that all companies outside Eretz Yisroel have some *aino Yehudi* ownership. *Tevila* is not required when one borrows or rents a *kli* from an *aino Yehudi*.

If the manufacturing company is Jewish-owned, and the *kli* is crafted by Jews and sold directly to Jews without any *aino Yehudi* middleman, the *kli* does not require *tevila*. For example, a kiddush cup manufactured in Israel and purchased there from a Jewish-owned store would not require *tevila*. However, one manufactured outside Israel would require *tevila* with a *bracha*.

A *kli* requires *tevila* whether it is bought or received as a gift from an *aino Yehudi*. This requirement would apply even if the Jew owned the *kli* originally, sold it to an *aino Yehudi*, and subsequently bought it back. If someone converts to Judaism, their *keilim* require *tevila* (without a *bracha*) even if they were only used for kosher food, since the *keilim* were transferred from the possession of an *aino Yehudi* to the possession of a Jew.

If a person buys a *kli* to give as a present, he can choose to *tovel* it beforehand, but this is not required. He should inform the recipient if he *toveled* it. If the item might be returned to the store unused, the giver should not *tovel* it before gifting it.

If a person buys a *kli* and fills it with food to give as a present (such as *mishloach manos*), the *tevila* requirement will depend on the worth of the *kli*:

- If the *kli* is not valuable, it is subordinate to the food and does not need *tevila* by the giver. The recipient can eat the food from the *non-toveled kli*. If the recipient wants to reuse the empty *kli*, he would need to *tovel* it.
- If the *kli* is valuable enough that it could be given as a present without the food, the giver should *tovel* it before filling it with food.

Miscellaneous Tevila Issues

If one received a used *kli* from an *aino Yehudi* which had been used with non-kosher food, it must be kashered first before it is *toveled*.

Any *kli* that requires both kashering and *tevila* should be kashered first.

If a *kli* that requires *tevila* was mixed with *keilim* that have already been immersed, and the *untoveled keili* is unidentifiable, all of the *keilim* should be *re-toveled*. If this poses a difficulty or expense, a *rav* should be consulted.

If one is invited to eat at a friend's house and it is known that the *keilim* have not been *toveled*, a *rav* should be consulted. If the host is a *shomer Torah u'mitzvos*, one may assume that he fully complies with halacha.

If, in error, *a non-toveled kli* was used to prepare food, the food is still considered to be kosher. The food must be transferred to a properly *toveled kli* before further cooking or consumption.

It is impossible to address all the issues and questions that may arise regarding *tevilas keilim*. When in doubt about a particular facet of this mitzvah, always consult a competent rabbinic authority.

See the STAR-K site for a handy list of *keilim* and their *tevila* requirements.[1]

1. See https://www.star-k.org/articles/kosher-lists/1170/tevilas-keilim-guidelines/.

Tevila Exemption for Appliances with Electronic Components

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For many years, Rav Moshe Heinemann *shlit"a* instructed STAR-K to advise consumers that electric appliances which require *tevila* – such as toasters, waffle makers and hot water kettles – can be *toveled* and left to dry for three days. I have given this advice probably thousands of times and never once had a call back that the appliance was ruined.

There are, however, appliances that have both *electric* and *electronic* components. Electric devices convert electrical energy into other forms of energy, while electronic devices control the flow of electrons to perform tasks. Once exposed to water, damage to electronics begins within seconds – and the longer the exposure, the worse the damage.

Printed circuit boards consist of a laminate containing fiberglass and copper-clad epoxy, which forms the circuit's wiring. This creates the perfect environment for galvanic or two-metal corrosion.[1] Water contains minerals such as calcium, magnesium, potassium and salt, which accelerate galvanic corrosion. Keurig- and Nespresso-type appliances have circuit boards and screens which cannot be safely *toveled* because they almost surely will not work afterward.[2]

A *kli* that contain electronics that will be destroyed if immersed does not require *tevila* according to Rav Heinemann.[3] The logic behind this ruling is that even though there is a positive commandment of *tevilas keilim*, that mitzvah is only fulfilled if the *kli* remains usable after the tevila. If *toveling* will ruin the *kli*, the mitzvah was not fulfilled. In that case, one is considered an *onus*, unable to perform the mitzvah, and the *kli* therefore may be used without *tevila*. ☆

1. See https://blog.acsindustrial.com/circuit-board-repair/can-your-water-damaged-circuit-boards-be-repaired/.
2. I once had the pleasure of disassembling and reassembling a Nespresso machine with Rav Heinemann (it took almost two hours!) to confirm that there was indeed a metal water heating tank inside that would require *tevila*.
3. For more details, see "Getting Into Hot Water: Urns and Pump Pots in Halacha – *Tevila* and Workplace," by Rabbi Zvi Goldberg, *Kashrus Kurrents*, Spring 2014, at https://www.star-k.org/articles/kashrus-kurrents/2177/urns-and-pump-pots-part1/.

Vinegar: Doing Kashrus Tastefully

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❷ *Acetic acid fermentation (acetification):* Next, the alcohol is further fermented into *acetic acid*, the main component of vinegar that gives it its sourness. There are two methods used for vinegar fermentation: the *traditional vat method* and the *acetobactor generator process:*

Traditional Vinegar Fermentation: In this method, the alcoholic liquid – usually wine – is placed in custom-made oak barrel casks fashioned with numerous holes to allow for ample aeration. The alcohol in the wine is slowly converted into acetic acid. Once the desired level of alcohol is reached, the vinegar is ready.

In terms of kashrus, the obvious requirement is that the wine used in the processing is kosher, *mevushal* and controlled by Torah-observant workers throughout the production. Any additional ingredients must be kosher, as well. Furthermore, the casks used for the fermentation may not have been previously used to ferment non-kosher vinegar or wine.

Acetobactor Generation: This system is used by modern-day vinegar manufacturers to produce large amounts of vinegar quickly and efficiently. The generators range in size from 6,000 to 18,000 gallons. The word *acetobactor* is a contraction of two Italian words: *aceto* (vinegar) and *bactor* (bacteria). Bactor refers to the bacteria used in these generators to convert the alcohol into acetic acid.

In lieu of fermentation, 190-proof alcohol is brought in as an external ingredient to be converted. The generators are filled with a solution of water, alcohol and vinegar from previous productions, along with bacteria (bactor), bacteria food nutrients and beechwood shavings. The generator is kept at a constant 85°F. The alcohol circulates through the generator and is converted into acetic acid.

A wide array of alcohols can be used for the conversion process. These alcohols may be derived from a variety of sources. Natural ethanol can be derived from corn, wheat or sugar; synthetic ethanol can be produced chemically. But ethanol can also be produced from potentially non-kosher materials. If the country of origin is a heavy producer of wine or grapes, there is a reasonable assumption that the imported alcohol was derived from grapes.

If a vinegar company uses grape-derived alcohol as their base product, all subsequent vinegar productions generated from this grape alcohol would be non-kosher. The repercussions of using non-kosher alcohol could be devastating. Vinegar is considered a *davar charif* – a product that is sharp and pungent. Since a *davar charif* is not *batel b'shishim*,[5] any condiments or sauces flavored or mixed with the non-kosher vinegar will be forbidden.

❸ *Filtration:* Each vinegar fermentation method undergoes a distinct filtration process:

Traditional Filtration: Stainless-steel plates and paper filters are used to filter out large solid particles. The vinegar is further filtered through a microporous fiber membrane to remove any impurities, among them unwelcome residents of vinegar production: *vinegar eels* – tiny nematodes that live in vinegar and typically reside in the vinegar barrels. These minute, round worms feed off of the bacteria that produce the vinegar and can grow to a length of 1/16" to 3/8". Filtration generally alleviates any *chashash* of vinegar eels. The end result is a clear vinegar.

Acetobactor Filtration: After being drawn off from the generator, the vinegar is filtered and standardized with water to its desired strength. In this process, diatomaceous earth and/or mechanical filters are used to remove any impurities, including vinegar eels discussed above.

Vinegar Strengths

The strength of the vinegar, known as *grain*, is determined by the percentage of acetic acid in the blend. 40 grain vinegar has 4% acidity, 50 grain has 5%, and so forth. These are typically consumer-strength vinegars.

Industrial-strength vinegar can reach 200 grain acidity. Generally, industrial-strength vinegar is 120 grain, with 12% acidity. The raw materials used in the fermentation process play a fundamental role in the taste, color and fragrance of the vinegar variety.

What is Glacial Acetic Acid?

Increasingly, industrial food producers are turning to glacial acetic acid over vinegar in their productions. In the United States, acetic acid can be chemically derived more efficiently and economically than through a vinegar derivation. Are glacial acetic acid and vinegar synonymous, and are there kashrus concerns? And does the term *acetic acid* mean that it must be derived from vinegar? The answer to all of these is – no!

Industrial glacial acetic acid is typically produced through a chemical reaction of *methanol* (a petroleum derivative) and *carbon monoxide*, or through oxidation methods of synthetic acetaldehyde. These processes do not present any kashrus concerns.

Acetic acid is vinegar's sour component. It can be concentrated to different strengths. When the acetic acid is concentrated to 12% acidity, or 120 grain, the acetic acid will freeze at 16.7°C (62°F). Acetic acid that possesses this property is commonly known as *glacial acetic acid*. The term *glacial* indicates a product that reaches this high freezing point.

Vinegar Types

There are numerous types of vinegar, each with its own processes and origins, including:

- *White Distilled* – from petroleum or fermented grains (e.g., corn, wheat); it is clear and tastes bitter
- *Apple Cider* – from fermented apples or cider; has an amber color and is more mellow
- *Wine* – from red or white wine; red wine vinegar has a deep red color
- *Rice* – from fermented rice; has a pale color and a mild flavor
- *Malt* – from fermented malted grains, such as barley or corn
- *Balsamic* – from fermented grape must
- *Flavored* – from infusions of herbs or fruit purees

Let's take a closer look at these last two.

Balsamic Vinegar

Balsamic vinegar is a classic Italian favorite and an excellent example of a traditionally-aged vinegar. Whereas regular wine vinegar takes one or two years to ferment, the conversion of *grape must* – freshly pressed grape juice – to balsamic vinegar requires up to a dozen years to age.

The production of balsamic vinegar is a long and careful process. The grapes are gently crushed and aged in special chestnut or mulberry barrels where fermentation and oxidation occur simultaneously. As the vinegar evaporates, it is transferred to smaller cherry and mulberry barrels for further aging. At the end of the process, the balsamic vinegar is thick, full-bodied and almost condiment-like in consistency.

While authentic balsamic can require up to twelve years of aging, some of the premium balsamics used in this process are significantly older.

5. i.e., nullified if there is 60 times more kosher than non-kosher in the product, or a 1:60 ratio.

In Modena, Italy, "mother" balsamic vinegars[6] can be traced back *four centuries*. Due to the complex task of tracing balsamic vinegar over such a long passage of time, authentic kosher balsamic is virtually impossible to verify.

A prized bottle of authentic balsamic vinegar can fetch between $150-$275 per 100 ml bottle.[7] The relatively inexpensive balsamic vinegar sold in the United States today is clearly not authentic balsamic. This mass-produced simulation consists of regular grape must mixed with balsamic wine flavoring and coloring, added to mimic the taste and appearance of authentic balsamic. The cheapest imitations are aged two years, a fraction of the time of true balsamic. Naturally, this shortcut is reflected in the price tag.

Infused Vinegar

One of the latest gastronomic trends borrowed from the recipe books of antiquity is the infusion of edible oils and vinegars. The original recipe as described in the Torah involves the compounding and mixing of the miraculous "anointing oil" of the Mishkan – the *shemen hamishcha*.[8] It was used when the *meleches haMishkan* neared completion and the *keilim*, *bigdei kahuna* and the kohanim themselves required special vesting of sanctity.

The principle, however, is the same: to give oil or vinegar a unique flavor through steeping them with herbs, spices, fruits or vegetables. As with any processed product, infused vinegars and oils require reliable kosher certification.

Halachic Questions Relating to Vinegar

▸ **Are wine and wine vinegars created equal?** There are many halachic differences between wine and wine vinegar. The bracha on wine is *Borei Pri Hagafen*, while the *bracha* on vinegar (in an edible state) is *Shehakol*.

Wine vinegar that was processed from *stam yeinam* (non-kosher wine or non-kosher grape juice) retains its non-kosher status. If an *aino Yehudi* touches *non-mevushal* wine, it becomes *stam yayin* and forbidden. Yet, kosher wine vinegar that was fermented under kosher conditions from *non-mevushal* wine does not become forbidden if touched by an *akum*.

▸ **How do the laws of *davar charif* apply to vinegar?** Halachically, vinegar is both *charif* and *avida d'taima*, sharp and pungent. Thus, it is halachically significant if a kosher product is soaked or mixed into vinegar versus into a sweet fruit juice. For instance, if a kosher product, such as a cucumber, is soaked in a non-kosher grape juice – halachically considered "mild" – the cucumber becomes non-kosher in 24 hours due to the principle of *kavush kemevushal*.[9] But, were it to be soaked in non-kosher wine vinegar, it becomes non-kosher in minutes – specifically, the time needed to boil the product, *k'dei sheyartiach al ha'eish*.[10]

▸ **How do the laws of *bitul* (nullification) apply to vinegar?** If non-kosher wine is inadvertently mixed into a kosher blend of fruit juices, the non-kosher wine is nullified if the ratio of non-kosher wine is less than 1:6 (i.e., one part in seven) – the *halachic* ratio required to nullify non-kosher wine when it is mixed with water. As noted above, nullification does not apply, however, to something that is sharp. So if non-kosher vinegar is mixed into a kosher blend of fruit juices, the vinegar is not nullified due to the fact that it is an *avida l'taima*,[11] added for taste.

Special Vinegar Productions for Pesach

Pesach, of course, presents a host of new kashrus issues. All the fermentation ingredients have to be Kosher For Passover (KFP). The critical ingredient in KFP vinegar production is the KFP ethanol (grain alcohol). KFP ethanol can either be naturally derived from beet sugar or produced synthetically.[12]

If the ethanol is derived from barley, rye, oat, wheat or spelt, vinegar produced from these sources is chametz. If the grain alcohol is derived from corn, rice or milo (a corn derivative), the vinegar is *kitniyos*, and permissible for use by Sephardim who eat *kitniyos* products on Pesach – provided that the other ingredients, such as the nutrients, are reliably KFP, as well.

The status of products using vinegar as an ingredient (e.g., ketchup, mustard, mayonnaise, salad dressing) depends on the grain used in their production. Grain alcohol in the U.S. is typically corn-based. In Europe, the grain alcohol may be chametz. This has ramifications with respect to the mitzvah of *chametz she'avar alav haPesach*. If the product is *kitniyos*, it does not need to be sold by Ashkenazim. But if the source is unknown, these vinegar-based products should be removed or sold with one's chametz before Pesach by both Ashkenazim and Sephardim.

Vinegar-Flavored Kalamata Olives

The Mishna in *Terumos*[13] explains that there are two distinct categories of olives: *oil-producing olives* and *table olives*.

Table olives do not contain a natural abundance of oil but can be produced into a tasty condiment. In fact, the commentaries on this Mishna instruct us that to make table olives edible, they must be fermented in a strong brine solution for many months. The liquid is then poured off and the olives are mixed in a new brine solution with a lower salt content.

Of the many regions that produce table olives, undeniably, the Kalamata region of Greece produces the "gold standard" table olive, hence, the name Kalamata olives. As you can imagine, the heralded recipe of classic Kalamata calls for wine vinegar.

To add flavor to table olives, vinegar is often added to the mix. Typically, olives that are produced as a commodity item are flavored with glacial acetic acid. But to create an outstanding table olive, the old-world recipe calls for wine vinegar, which requires strict kosher supervision and is far more expensive than its non-kosher Greek counterpart.

Today, Kalamata olives are not limited to the Kalamata region in Greece any more than Bordeaux wine is limited to Bordeaux, France. But without question, the ultimate flavored table olive is produced with wine vinegar.

Of course, there are industrial tricks of the trade. Economically, glacial acetic acid is far cheaper; moreover, after a short while, the brine turns purple and will look just like wine vinegar. Due to the similarity between glacial acetic acid and wine vinegar, there is a risk of substitution. Kashrus agencies, therefore, require *hashgacha temidis* for vinegar-flavored table olives.

Conclusion

Thinking about vinegar, its fascinating processes and myriad of uses, one can draw a profound life lesson from Hashem's wonderful creation: there are times when one feels as though life has dealt them an unfair hand, yet we believe that things will eventually turn out for the best[14] – just as sour grapes turn into sweet success. ☆

6. A "mother" refers to a culture of beneficial bacteria and yeast that transforms alcohol into acetic acid, (i.e., vinegar).
7. 100 ml is roughly 3 oz.
8. The *shemen hamischa* was created to last for all eternity and is reserved for this one specific purpose; its "recipe" may never be duplicated.
9. *Y.D.* 105:1. This principle states that it takes 24 hours for a kosher product soaking in a mild non-kosher liquid to be imbued with the liquid's non-kosher properties. A sharp or pungent liquid, "*davar charif*," would achieve its goal much more quickly.
10. *Y.D.* 105:2.
11. *Y.D.* 98:8 *Rema, Taz* 11. The principle of something that is *avida l'taima* is not *batel b'shishim* as long as one can taste the vinegar.
12. Kosher wine vinegar is typically KFP. Apple cider vinegar can also be produced KFP provided all of the ingredients are Passover-approved.
13. *Terumos* 2:6.
14. *Brachos* 60b:12 – *kol d'avid Rachmana l'tav avid* (everything Hashem does, He does for the best).

TORAH, SCIENCE & KASHRUS IN THE CLASSROOM

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chemical, that was then filtered and harvested. This lifesaving, active pharmaceutical ingredient is added to pills, tablets and liquids used by millions to treat a host of infections.[2] From a halachic standpoint, the possible chometz status of the growth media explains why amoxicillin made at this company is listed as "may contain chometz" in the *STAR-K Pesach Guide* medicine list, prepared each year by Rav Gershon Bess *shlit"a* and published in conjunction with Kollel Los Angeles. This is an excellent example of the interplay of biology and kashrus.

CHEMISTRY

Principles of chemistry are the building blocks of the food industry. As many of us learned in high school chemistry class, when two substances are chemically combined, a reaction forms, creating a completely new product.

When a mashgiach goes to inspect a manufacturing facility, he needs to determine which raw materials reacted together, what processing aids were used (even if they were filtered out after the production), and what else was made on the company's equipment. Safeguards include checking what other products the company is manufacturing at the site, reviewing common steam lines, and identifying ingredients that have both kosher and non-kosher versions and which could be inadvertently swapped during a production.

Some kosher-sensitive ingredients produced through chemical reactions include:

- **Triacetin** - a plasticizer made by reacting *glycerol* (derived from animal, vegetable or synthetic sources) with *acetic anhydride*.
- **Polysorbate 80** - known chemically as sorbitan monooleate, is used as an *emulsifier* (i.e., an additive that helps two liquids such as oil and water mix) in salad dressings and in frozen desserts such as ice cream. Polysorbate 80 is both kosher-sensitive and Pesach-sensitive, because it is made by reacting *sorbitol* (derived from chometz in Europe) and *oleic acid*, a fatty acid possibly derived from non-kosher animal derivatives.

Some chemical reactions use chemicals that we would never dream of eating to form ingredients that we consume daily. For example:

- **Propylene oxide** - an acutely toxic and extremely flammable chemical, is combined with water to form *propylene glycol*, which is used to dissolve flavor ingredients in drinks. It also prevents powdered ingredients from caking.
- **Carbon monoxide** - is a well-known poisonous gas. When carbon monoxide reacts with ethylene and water, the result is *propionic acid* which is also used as a food preservative in bread and other baked goods.
- **Isobutene** - another highly flammable gas, is used to make *polyisobutylene*, a chemical that can be transformed into a slightly sticky substance used on the back of sticky-notes. Why does such a product require a hechsher? Because it is also used in the production of chewing gum! Just as a sticky pad requires a weak adhesive so it does not tear the paper it is affixed to, chewing gum should not be "super-glue" sticky or it would never come off one's teeth.

PHYSICS

Physics involves the study of the interactions between objects and energy in a given environment. This includes what happens when equipment is heated to very high temperatures, which is a regular occurrence in factories, both in the course of kashering a facility as well as during regular productions. I found it most intriguing to have recently seen chemicals exceed 700° C (about 1,300° F).

When STAR-K requires special kashering of a factory, a mashgiach must be present to ensure that it adheres to kashrus specifications. The kashering can include kettles, reactors, stainless-steel piping and micronizers (which reduce the diameter of solid particles), among many other types of specialized production equipment at the site.[3] Spray driers that often take up several floors of a factory and convert emulsions into powders require extra attention; a great deal of energy is needed to heat this type of equipment.

Another application of physics with halachic ramifications are *induction cooktops*. which heat ferrous metals using strong magnetic fields. When a metal pot is placed on the cooktop, the pot begins to heat up; when the pot is removed, the heating process ends. Due to these scientific properties, induction cooktops may not be used on Shabbos or Yom Tov and cannot be Sabbath Mode certified.

SUMMING UP

Kashrus is greatly impacted by science. A basic knowledge of chemistry can help a kashrus administrator or field representative understand whether certain chemicals are "kosher-sensitive" or if production equipment was compromised through reacting with non-kosher chemicals.

As the world becomes more and more technologically advanced, science becomes even more relevant. The following are contemporary examples where science and kashrus certification intersect:

- **Genetically Modified Organisms** (GMO's), first approved for consumer products by the FDA in 1982, have been reviewed by *poskim* and are generally considered kosher (albeit kashrus agencies typically do not address health and ethical issues regarding such items).
- **Artificial Intelligence** (AI), a much-discussed topic these days, affects many industries – including farming and food production. How AI promotes or hinders kashrus and how agencies adapt to these new realities remains to be seen.
- **Bionaphtha,** produced from recycled oils, requires a firm understanding of the science behind it to determine its kosher status.
- **Food Colors,** produced from natural sources that are replacing certain banned artificial colors, likewise need scientific analysis to determine if they are kosher.
- **Satellites** can now track fields in Israel during the *Shemita* year.

Incorporating the practical halachic scientific applications into school curricula is a creative way to make the lessons more interesting and to help students retain those lessons even after they have left the classroom. Presenting the material in this way also helps to illustrate to them the *niflaos haBorai* – and may even serve to inspire the next generation of kashrus professionals.

As kashrus continues to evolve within a fascinating world of scientific advancements, STAR-K and all kashrus agencies should have the *syata di'Shmaya* to continue to serve Klal Yisroel *ad bi'as goel tzedek*.☆

2. Penicillin was discovered in 1928 by Dr. Alexander Fleming when he observed penicillium mold, which can grow on bread, produce a self-defense chemical that could kill bacteria. Rav Moshe Heinemann *shlit"a* often quotes the Mishna in *Pesachim* (39b) that says on Pesach one may not chew on wheat and place it on his wound because it becomes chometz. It is fascinating how Chazal understood the therapeutic capabilities of moistened wheat-based products, which were the forerunners of modern-day antibiotics.

3. Equipment which stores non-kosher liquid (or non-kosher solids in liquid) for 24 hours becomes non-kosher even without heat (see *Y.D.* 105:1). Such equipment is difficult to kasher becaues it typically does not have a heating source.

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INDUSTRIAL PRODUCTS

ACG CELLULOSE
India
CELLULOSE

ADUSA DISTRIBUTION
Salisbury, NC
RICE

AKAY INDUSTRIES
India
FOOD COLORS

APIBEE NATURAL PRODUCTS
India
HONEY

ARTUR LOGISTICS
Southampton, PA
KOSHER TRANSPORT

AVISTA TECHNOLOGIES
San Marcos, CA
DETERGENTS & CLEANSERS

BVC SPECIALITIES
India
INDUSTRIAL CHEMICALS

CAMBODIAN GOME FARM FOOD
Cambodia
DRIED FRUIT

COCO HARVEST
Philippines
COCONUT PRODUCTS

DIAMALT COLLOIDS
India
FOOD GUM

FERGANA ORGANIK TARIM
Turkey
DRIED FRUIT

GAOMI CITY RONGCHUAN FENGLIN BIOTECH
China
SOYA PRODUCTS

GREEN AGRO PACK
India
PICKLED PRODUCTS

GREEN HILLS SPICES AND EXTRACTS
India
ESSENTIAL OILS & OLEORESINS

GUANGDONG LIANGSHI INDUSTRIAL MATERIALS
China
INDUSTRIAL CHEMICALS

HEBEI DEREK CHEMICAL
China
INDUSTRIAL CHEMICALS

HENI DRUGS
India
FOOD CHEMICALS

HUBEI XINXUANHONG NEW MATERIALS
China
FLAVOR CHEMICALS

HUNZA SUGAR MILLS
Pakistan
INDUSTRIAL CHEMICALS

ILERA OILS AND FAT
Nigeria
VEGETABLE/SEED OILS

INDO GLOBAL
India
SPICES & OLEORESINS

INNER MONGOLIA QUANGUHUI FOOD TECH
China
NUTS AND SEEDS

JIANGSU WESTPOINT PHARMACEUTICAL EXCIPIENTS
China
FOOD ADDITIVES

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Sweden
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Kearney, NJ
NUTS AND SEEDS

OXKEM
United Kingdom
INDUSTRIAL CHEMICALS

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Baltimore, MD
SPICES & SEASONINGS

PREMIER INDUSTRIAL CHEMICAL
Pakistan
INDUSTRIAL CHEMICALS

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Tunisia
VEGETABLE/SEED OILS

RICE HULL SPECIALTY PRODUCTS
Stuttgart, AR
RICE PRODUCTS

SANKALP ORGANICS
India
STEARATES

SEMES GIDA
Turkey
JUICE & JUICE CONCENTRATES

SGD TRANSPORT
Holiday, FL
KOSHER TRANSPORT

SHANDONG NEW WEITAI BIOTECH
China
AMINO ACIDS

SHANDONG RUNHAN BIOTECH
China
VITAMIN COMPONENTS

SHREENIDHI OILS & FOODS INGREDIENTS
India
LECITHIN

SIOS-ZITEX
Tunisia
VEGETABLE/SEED OILS

SPRAY DRYING AND CHEMICALS
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FOOD ADDITIVES

STARDEX GLOBAL FOODS
India
STARCHES & STARCH PRODUCTS

STRIK BV
Netherlands
VEGETABLE PROTEIN

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China
SOYA PRODUCTS

TIANJIN DACHENG IMPORT & EXPORT TRADING
China
NUTS & SEEDS

TIANJIN SHINHOO FOOD
China
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TIGERS EXPRESS LOGISTICS
Iselin, NJ
KOSHER TRANSPORT

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This summer, once again, STAR-K will be offering the following popular training seminars at its Baltimore corporate headquarters:

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SIGN UP NOW!

For more information, contact Rabbi Zvi Goldberg, STAR-K's seminar coordinator, at 410-484-4110 ext. 219.

Early registration is advised as each program is limited to 25 attendees and spaces fill up early.
To download an application for either seminar, please go to **star-k.org/training.**

STAR-K KOSHER CERTIFICATION

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This feature on ovens does not permit cooking or reheating food on Shabbos.

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