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Analysis of ethylene oxide and 2-chloroethanol in sesame seeds and other food commodities

January 19, 2022, 2:00pm-3:30pm EST

Ethylene Oxide (ETOX) is a gas that can be used as a fumigant on certain products intended for human consumption in order to reduce bacterial contamination, particularly salmonella. Several challenges are encountered when it comes to the analysis of ETOX and 2-CE in various food products: mainly due to the accumulation of high amounts of nonvolatile material in the liner, column, and possible interference with Acetaldehyde.

This webinar, in partnership with RIC, is intended for those who want to discover how to optimize the method for ETOX and 2-CE quantification. You will learn how to overcome the analytical challenges and how a novel, robust and automated method can be implemented in your lab.

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The Issue of Undeclared Ingredients in Halal and Kosher Food Production: A Focus on Processing Aids

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Abstract: Since the early 1900s the food industry has undergone major advances that have led to more than half of the shelves in a modern supermarket being stocked with packaged and processed foods. These boxed, canned, and frozen foods achieve their convenience by using a number of food ingredients and processing aids. The original sources and the details of their processing prior to inclusion in the final food product are not provided to consumers but will determine their acceptability for both halal and kosher food production. While additives are generally declared on a product label, processing aids are not shown on the ingredient statement and thus the consumer is not even aware of their presence. Some additives can be legally grouped into generic categories (such as spices) that also make it difficult for consumers to determine what exactly is in the products they buy and how these products have been processed. Thus, consumers need to put more pressure on the kosher and halal marketing system to use trademarked symbols that represent an organization that the consumer can hold accountable and which provides both the companies and the consumer with confidence in the kosher and/or halal status of the products being offered in the marketplace.

Introduction and Background

For many years, and even today, in many Muslim majority countries obtaining halal food simply meant buying meat from a halal butcher who locally slaughtered the animal in accordance with Islamic principles, and meeting the local standards. Other foods that were not prepared at home were prepared by Muslims in the community. So the link between consumer and producer was direct. The kosher consumer also obtained food locally from purveyors in the community so that the local religious leaders could easily supervise food production even if produced by a non-Jewish processor or merchant.

Now halal has become a global megatrend as the food supply is more often than not no longer produced locally, even in developing countries. Thus, providing halal foods to about a quarter of the world's population offers many economic opportunities for the food industry, but it makes assuring the halal authenticity of these products more difficult. The kosher consumers, who are a subset of the Jewish community, have developed a system of trademarked labeling on packages of food to identify the responsible party providing kosher certification. Thus, the degree of accountability for

kosher foods is often fairly high, although improvements are still needed. The development of a similar trademarked identification system for halal products is still in its infancy as discussed later.

The kosher and halal food laws have been described in detail by Regenstein and others (2003) and deal with the allowed animals with the pig being the commercially important unacceptable animal. All allowed mammals and birds must be religiously slaughtered. In addition the Muslim community does not permit the use of alcohol and the Jewish community requires a complete separation of milk and the meat of kosher mammals and birds. In addition the kosher laws are extended into the plant kingdom for the 8-d holiday of Passover.

According to the Pew Forum on Religion and Public Life (2009), which undertook a global survey of religious identification, there are 1.6 billion Muslims living in more than 100 countries. Thus, between 20% and 25% of the world's population is Muslim. This is a potential market that remains surprisingly neglected during the drive for globalization. As a religious requirement, Muslims are required to consume only halal food products. An estimated 70% of all Muslims globally do adhere to at least some of the restrictions associated with halal foods (Riaz 2012), most commonly the avoidance of pork and its derivatives. As a result, the halal food market as an identified market for companies to serve has been in a strong growth phase during the past decade, although it has a long way to go. The halal market is now, according to Agriculture and Food Canada's Agri-Food Trade Service, an international market that in 2010 represented about U.S. \$660 billion of trade (Riaz 2012). Locally made and sold halal foods are generally not included as their impact is difficult to capture.

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The kosher market is most developed in the United States, but other countries, particularly in Europe, have identifiable markets. For example, it is estimated that about 35% to 40% of packaged goods in a typical American supermarket are certified kosher. And it is estimated that of the about 15 million U.S. consumers who intentionally purchase kosher food, only about 20% are Jewish. The use of marketing slogans such as “Hebrew National, We Report to a Higher Authority” and “You Don’t Have to be Jewish to Enjoy Levy’s Kosher Rye Bread” has made the kosher mark in the United States into a strong and positive marketing tool for food companies.

Role of Processing Aids

Processing aids are used by manufacturers to help solve many product-processing needs without being required to be declared on the food label by law in most countries. Processing aids cover everything from the lubricants used on equipment that come into contact with food to agents that help with peeling fruits and vegetables. They are used to provide many useful functions and desired effects during the manufacture of foods, but are not meant to be part of the final product’s ingredients. Thus, they are not required to appear on a product’s ingredient label (Codex Alimentarius Standard 1981).

However, the use of many different processing aids may result in the nonintentional but unavoidable, presence of residues or derivatives of these compounds in the final food product. Note that all of these materials must be approved for use with foods, and their presence in the final food must be totally consistent with food safety. Like some ingredients, some of these processing aids may not be suitable for halal and kosher food production (FSIS 2008). Obviously, the consumer cannot directly determine their presence and must rely on the manufacturer to be sure that these processing aids are consistent with any claims being made. For example, a typical processing aid might be the materials used to lubricate food-processing equipment such as metal conveyor belts. The presence of an animal fat, such as lard (pig) or tallow (cow, goat, and so on) in these substances might well make the food product not kosher, not halal, not vegetarian, and not vegan. But who is checking on the use of these processing aids and of the source of other ingredients on behalf of the consumer? This is an obvious role for an outside auditor. For those agencies providing religious supervision, this is a critical component of their certification process.

Formal definitions of the term “processing aids”

According to the Codex Alimentarius standard (1981), processing aids are:

- (a) Substances that are added during the processing of a food but are removed in some manner from the food before it is packaged in its finished form;
- (b) Substances that are added to a food during processing that are converted into constituents normally present in the food, and do not significantly increase the amount of the constituents naturally found in the food; or
- (c) Substances that are added to a food for their technical or functional effect during processing but are present in the finished food at insignificant levels and do not have any technical or functional effect in that food.

No generalized regulatory criteria exist in most countries for judging exactly what constitutes an insignificant level of a processing aid. Each application to be considered as a processing aid must

be submitted to the relevant regulatory authority where such an authority exists and where it takes on the responsibility of regulating process aids. This will usually require that the decision for a particular compound for a particular application will need to be handled individually. This leads to further confusion in the marketplace and with consumers because these decisions are being worked out differently in different countries using a process that is not always public (Hegenbart 1990) and to date most national authorities have not tried to regulate the use of processing aids in other countries. It is unlikely that this will change in the near future, although many countries where halal foods are the assumed default in the marketplace are beginning to recognize this problem as the requirements for importing foods into these countries become more stringent.

Determining the use of processing aids is one of the most important roles of the religious supervision auditor. And this often requires truly understanding the product from its start to finish, including all subingredients. The fact that many of these compounds are at levels below those that traditional testing can detect means that laboratory testing can only be an adjunct to actual supervision and to have a high-quality religious supervision clearly requires the supervising agency to understand the complexity of the modern food industry. During the certification process, an auditor will be able to review the flow diagram and all the processing aids used during the food’s manufacturing process and will determine if these are suitable for halal and/or kosher certification.

The decision as to what is allowed as a processing aid by the secular governments may surprise many readers. One such example is the use of water as a processing aid in cookie and cracker production. The water added during dough making qualifies as a processing aid because it is solely present in the formula to make the mixable, formable mass (dough) that is used to create the final product. During baking the water level is reduced to about 2% to 3% of the final product. Because these levels are low and are equal to or usually less than the combined moisture content of the original ingredients used in the formulation of the dough, the water added in these applications is treated as a processing aid (Hegenbart 1990).

Another less benign example, which may pose issues for the production of halal, kosher, vegetarian, and vegan foods occurs in the beverage industry. The example is one where the processing aid is removed from the product after serving its purpose. These are the materials that manufacturers use to clarify fruit juices, for example, they are added to remove tannins. But, in fact traces of these clarifying agents may remain, although they are definitely not meant to be in the final product. Gelatin alone or in conjunction with some other gums may be added to juices (most commonly to apple juice) prior to the final filtration step (Blech 2008). These gelatins and gums bind the various juice-clouding materials to form an insoluble precipitate. When the juice is filtered, the precipitate is no longer part of the product. Thus, both the clarifier (the gelatins and gums) and the tannins are removed. So a cloudy apple cider becomes a clear apple juice. The same process is used in preparing some types of vinegar. But for Muslims, Jews, vegetarians, and vegans many of these gelatins are questionable or forbidden. Their bulk removal does not change the nonhalal or nonkosher status of the juice as their presence in the juice has made it haram (forbidden to Muslims) or treif (forbidden to Jews). Their eventual removal from the liquid does not undo this change in status of the juice.

Gelatin and also xanthan gum, one of the possible gums used in these applications and in many other food processes, can serve

as models for some of the issues that need to be considered for processing aids/ingredients when it is desired to produce products for the religious foods market.

In general, the fact that something is used by the food industry as a processing aid instead of as an ingredient does not in most cases change the impact of the ingredient on the kosher or halal status of the final product.

Gelatin is inherently an animal product, derived from collagen, the most ubiquitous protein in higher animals. Thus, like all animal products, there is the issue of whether the raw materials were obtained from animals that were religiously slaughtered. Both Muslims and Jews require that animals be slaughtered uniquely to meet their religious requirements (Regenstein and others 2003; Regenstein 2012). For products derived from slaughtered animals to be acceptable to the normative practitioners of these rules, these products must come from animals that have been religiously slaughtered (Regenstein 2012). This means that, in principle, many of these animal-derived products available commercially are unacceptable because currently very few such products are derived from either kosher-slaughtered or halal-slaughtered animal byproducts (Regenstein and others 2003).

Halal and kosher meats are generally available for direct consumption, but very few of these meat processing facilities are set up to process the byproducts of religiously slaughtered animals at this time, so those become comingled with the regular byproduct streams. In the future it is to be expected that an infrastructure will be developed to take halal-slaughtered byproducts that are identity preserved as a source of halal animal byproducts. This is slowly happening for a few of these materials and more animal byproducts are becoming available as halal. It can be anticipated that more such byproducts will be available as the market grows.

Obviously, for Muslims any material prepared from pork is prohibited. Thus, for a halal gelatin to be sourced from a mammal, it will need to be either beef (currently available) or sheep/goat/bison/water buffalo (not currently available) from halal-slaughtered animals.

However, the Jewish approach to gelatin, but not most other animal-derived products currently used in the food industry, is a little more complex. Most such materials derived from animal byproducts not religiously slaughtered are, just as with halal, simply unacceptable. But gelatin remains a more complex situation in Jewish law. The source of gelatin is normally bone and hides. These are not considered to be edible products by the rabbis and are “technically” not covered by the rules concerning the use of “flesh.” Thus, some, generally more liberal, orthodox Jewish rabbis will even accept pork gelatin. A 2nd group of rabbis only permit regular (nonreligiously slaughtered) beef gelatin but not pork gelatin. Other rabbis only allow beef gelatin from bones uniquely collected in India that have been weathered for over a year or more from animals that have died naturally. This allows the rabbis to invoke another concept in the Jewish legal system known as “dry as wood.” But all 3 of these types of gelatin are rejected by the normative standard that is used by most kosher certification organizations in the United States (and elsewhere). Thus, for the bulk of the kosher market and most large kosher-certifying agencies, the only gelatin that is accepted must be prepared specifically from kosher-slaughtered animals. This type of gelatin is available in very limited amounts and is significantly more expensive than regular gelatin.

In recent years with the commercialization of fish gelatins, these fish gelatins are finding greater acceptance in products serving the needs of both the Jewish and Muslim communities. The majority

of these gelatins comes from fish with fins and removable scales, a requirement for the Jewish community and acceptable to almost all Muslims. Many Muslims will also accept fish without scales and some or all of the traditional shellfish species, but other Muslims only accept fish with fins and scales. So gelatins made using fish such as catfish (no scales) or sturgeon (nonremovable scales) will require a decision about their acceptability by different Muslim communities. Products using fish gelatin (such as gummy bears and marshmallows, and some “mousse-type” products) are available commercially in the United States.

For those Muslims who use kosher products and are concerned about the source of the gelatin, it is important that they learn to identify the trademarked kosher markings of the normative mainstream kosher supervision agencies that do not accept any gelatin other than those obtained from fish gelatin and/or religiously slaughtered raw materials. In the United States fish gelatin must be identified as such because of allergen concerns and this has limited their use in mainstream products. The words “kosher gelatin” in the ingredient statement of a product with a kosher marking on the package should not be relied upon by anyone who would not accept a gelatin other than from a religiously slaughtered animal or from fish. Furthermore, many of these products use a “generic K,” the letter “K” with no adornment, which cannot be trademarked and should be a signal that the product is potentially made from a non normative gelatin.

With respect to xanthan gum, the issue that makes this material different from most other hydrocolloid gums is that it is obtained as a product through a microbial fermentation. Thus the organisms that produce the xanthan gum need to be grown in a medium that is acceptable for kosher and/or halal production. Microbial products are also generally prepared using a bioreactor. So it is important to understand how these systems work.

The media used in the bioreactor systems usually require a complex mixture of ingredients for raising microorganisms efficiently. These ingredients all need to be checked to be sure they are coming from acceptable sources. Traditionally, many hydrolysates are used in these systems. These may have 2 problems. If they use an animal hydrolysate they are not likely to come from religiously slaughtered animals. But even if they are plant hydrolysates, the enzymes used for the hydrolysis may have been derived from slaughtered animal products, including porcine sources.

Some of these enzymes are unique to animals, while others may be available from multiple sources. Among the most common potentially animal-based enzymes are pepsin, rennet (see later), lipases, and catalase. Even the normal milk-clotting enzyme system, rennet, is a potential concern since it comes from the 4th stomach of a milk-fed calf after it has been slaughtered. However, in modern times most cheese makers are using microbial chymosin, the main milk-clotting enzyme produced in a bioreactor. (See below for more discussion of biotechnology.)

Bioreactors provide an example of an additional concern that is much broader than just the bioreactor. If a piece of equipment such as a bioreactor is used with ingredients that are not religiously acceptable, the equipment becomes haram or treif. The task of making equipment kosher or halal is complex and depends on just what was done. And some materials once made unacceptable cannot be made acceptable. Please see Regenstein and others (2003) for some further details, recognizing that the final process that is required will be determined by the supervising religious leader after a detailed analysis of all the factors involved.

Now turning to other ingredients of interest: Alcohol is often used as a hidden ingredient or processing aid in many foods (Halal

Consumer Group 2012). Most flavors are dissolved in alcohol, often sold as vanilla extract, almond extract, and so on. The term “extract,” at least in the United States, means that the product must be in a solution that is over 40% alcohol.

The issues with alcohol for kosher and halal food products are somewhat different. For halal, the very presence of alcohol is a concern since alcohol is forbidden. Many food products have trace amounts of alcohol and the Muslim since its community often uses postprocessing testing to determine if there are alcohol-related problems with a food product. Thus, various halal supervision agencies and governments involved in halal certification are trying to set trace alcohol level standards for modern food processing that respect the tradition but do not eliminate many food items that have been consumed for centuries. Currently, Islamic Food and Nutrition Council of America (IFANCA), which is the largest halal certification agency in the United States (and probably globally for a private halal certifier, a nongovernment supervision agent) uses the standard of 0.5% in ingredients and 0.2% in finished products. The higher level of alcohol in ingredients is based on the idea of allowing the food industry to use alcohol in the manufacture of products, generally, the alcohol is used for extractions as a solvent that is mostly hydrophilic but not as hydrophilic as water. When one “dries” such products, the residual powder is often near or below 0.5%. The 0.2% allows these ingredients and also products like orange juice and vinegar to be acceptable under normal laboratory testing circumstances. Other halal certification organizations are also trying to address this issue and a common set of figures for trace alcohol levels may (or may not) emerge in the next few years. The highest figure currently floating around is a 1% final alcohol standard, which is problematic as a sufficient amount of food/beverages with that amount of alcohol can lead to mild intoxication, which is the basis for the prohibition.

For kosher the issues around alcohol are more complex as alcohol is permitted, which is one of the major differences in the dietary laws of the 2 religions. However, any alcohol derived from grapes and grains is subject to additional stringencies that require the rabbis to be certain of the source of alcohol. Although, in principle, the actual source of the alcohol can be determined after the fact, these tests are expensive and require many “authenticated samples” of known origin, so supervision from the point of production is normally required. Grape alcohol requires religious participation in the pressing of the grapes and the subsequent alcohol production, so ordinary commercial grape alcohol cannot be used. For more details see Regenstein and others (2003) where the concept of “heated wine” is discussed. Another complexity in recent years has been the availability of marc alcohol, which is a second extraction of the grapes using a hot sugar solution and the pomace from the first pressing of the grapes. Its status remains controversial in the normative orthodox Jewish community and it is also generally not acceptable.

With respect to grain alcohol, the 8-d holiday of Passover in March/April has many restrictions on the use of grains and related materials, so again the tracing of alcohol and many other plant-based materials becomes necessary for Passover food production. Although wheat, rye, oats, barley, and spelt are prohibited in Hebrew Scriptures, most Western rabbis have added other grain-like materials, specifically corn and rice which can also be a source of alcohol and are thus prohibited during the holiday.

A few other substances are of interest with respect to grapes and wine. Cream of tartar is obtained from wine caskets while enocanina is obtained from grape skins after pressing the grape juice. So a religious decision as to their acceptability is needed.

A few other ingredients commonly used in food products may cause problems. A common source for ingredients of concern is the products that are essentially derivatives of fats and oils. When triglycerides are used as a raw material, one gets ingredients/processing aids that fall into such classification as diglycerides, monoglycerides, stearates, palmitates, polysorbates, glyceryl abietate (ester gum), lecithin, sorbitan fatty acid esters, stearyl lactylates, lard, tallow, and glycerin (glycerol; Lipschutz 1988). Given the wide variety of fat/oil sources, these products can be derived from vegetable, animal, and/or petroleum sources (Goldberg 2012). Thus, all of these products must have their halal and/or kosher status established. This means assuring that there are no animal products present in the vegetable or petroleum-based fatty alcohol. Note that both communities permit materials derived from petrochemicals that have not become contaminated (Regenstein and others 2003).

An interesting concern that exists in the United States is the fact that 100% pure vegetable oil can legally contain up to 0.1% of additional ingredients and these do not have to be plant-derived, which means animal products are permitted. However, it is also the case that the industry in the United States keeps the vegetable oil and animal oil systems separated and so the use of an animal-based additive is not normative as it would contaminate the entire vegetable oil system. However, the situation in other countries would have to be carefully checked.

There are other examples of products where the presence of fat/oil derivatives might not normally be expected, which again highlights the need to really understand food processing practices. Turmeric is used in processed food products but is not available as a 100% pure ingredient. Emulsifiers such as Polysorbate 60 or 80, which are fat-based emulsifiers, are added as a processing aid to help distribute the turmeric in dry or liquid food systems. Dry mix blends also benefit from small amounts of oil to keep ingredients of different densities from separating out of the blend. Oils also can act as flow agents. For example, oils help to keep many dried fruits, such as raisins, from forming large blocks upon storage. All of the above uses are considered processing aids. Additionally, hygroscopic powders (those that like to absorb water) such as hydrolyzed vegetable protein or sodium stearyl lactylate that remain free flowing with the addition of oil, which acts as a moisture barrier. These obviously need to be checked (Lipschutz 1988).

In addition, certain ingredients may be derived from animal products. Both vitamin D3 and lanolin are made from sheep's wool, while cysteine may be obtained from feathers (chicken, duck) or hair (pig or human). If the wool, feathers, or hair is obtained from slaughtered animals, this raises religious issues that must be decided by a religious decisor. Human hair is a concern for both religions (Lipschutz 1988).

Calcium carbonate may be obtained from shells of coral or oysters. Phenylalanine, inosinic acid (inosinate; disodium inosinate), and guanylic acid (sodium guanylate) may be derived from animal sources. Carmine (cochineal, carmic acid) is extracted from dried insects (body of the *Coccus cacti* bug). Thus a religious ruling may be required for all of these materials (Lipschutz 1988).

Again the kosher aspects of many of these materials needs to be considered separately as some of these prohibited compounds may qualify as a “pogem” or bittering agent. These are ingredients that are considered to have such a bad taste that even if it is from an unacceptable source, it would be acceptable. A bittering agent may be intentionally used to allow a piece of equipment that is not kosher to become kosher in less than 24 h. Because

these compounds are “bad tasting” compounds, their flavor when absorbed by the equipment (made of materials that can be subject to equipment kosherization) makes the equipment taste bad. These compounds can be used along with a subsequent clean water rinse to make equipment kosher. Since soaps and detergents are often considered to be bittering agents, the source of such materials may not be important to the rabbis, so that the cleaning and subsequent rinse actually make the equipment ready for kosher production. However, where possible the rabbis still prefer that these materials are made from plant or petrochemical feed stocks. So, again, Muslim consumers may need to inquire about the use of such materials. However, it should also be noted that the major use of this concept is in cleaning equipment and the careful cleaning of equipment in a modern food plant in general meets halal requirements.

An issue that must be discussed is the question of whether kosher animal products can be considered as halal. This is a somewhat controversial issue with respect to how different supervision agencies and Muslim consumers deal with the issue of “al kitabe,” the people of the book. The production of materials by people of the book (Christians and Jews and other groups who follow some or all of the Hebrew and Christian scriptures) is in general permitted, although it must also, in fact, meet the traditional halal standards. Also of concern is whether any product meets the supervision agency’s approach to alcohol, clearly a key practical and religious difference between the 2 communities.

For kosher the analysis of the impact of trace materials as already implied in the discussion of bittering agents is somewhat different. For items that are not a “flavor” ingredient, the accidental presence, mostly after the fact, of less than 1/60th (1.6% v/v) of such a material is permitted. It certainly cannot be intentionally added by a Jew, but the question of whether a non-Jew, who adds it with the intent of getting rid of it, for example, the gelatin added for clarify a fruit juice, is acceptable as one that will vary with the kosher supervision agency. Some rabbis will permit the use of such a product. Thus, it is difficult to determine the actual standard that a particular religious certification agency will take with respect to specific ingredient cases unless they are queried specifically.

Ingredients in principle are supposedly labeled on the package of a product. However, in accordance with government regulations, in many cases a generic term such as “spices” or “flavors” allows many ingredients to be grouped together such that a consumer might not actually know what is in the product and whether it might have been produced in a way that was unacceptable. For example, an oleoresin flavor may contain a fat/oil component that is treated as a processing aid. It is also important to recognize that the current food labeling laws in most countries do not have any requirements to identify the source of an ingredient, so most ingredients that can come from a multiple source are not labeled in terms of the source unless there is a potential allergy problem. An interesting exception in the United States is the labeling of fruit and vegetable coatings. These need to be identified on the packing box and on a general sign in the supermarket. These labels use terms like animal, plant, petroleum, or lac resin (shellac, an exudate of the lac beetle) allowing consumers to actually know the source of the material. The fruit and produce industry has reacted to this law by working globally to leave all animal products out of the coatings so as not to offend Muslims, Jews, vegetarians, and vegans.

A very common example of an ingredient that is not a processing aid, but whose presence may not be indicated directly in the ingredients statement, is monosodium glutamate (MSG). Because

some Muslims are concerned with compounds that are Makrooh (suspect items are not haram, prohibited, but are of sufficient concern for human health that the community is concerned about their presence in food). MSG might be on some such lists of suspect compounds. While MSG is sometimes listed directly in the ingredient statement, for example, when it is directly added, it is more frequently added as part of a more complex mixture which hides the fact that a major goal in using the ingredient is adding MSG. Examples of such ingredients include yeast extract, tomato powder, autolyzed vegetable protein, or hydrolyzed vegetable protein. All of these ingredients contain significant amounts of the flavor enhancer monosodium glutamate. Therefore, a consumer may not realize that MSG has been specifically added to the product. For Muslims, if MSG is a suspect compound, then the intentional adding of such a material, even when disguised on the label, would be a problem. For kosher, the issue of which source of raw materials was used and which enzymes were used remains as critical as it does for halal. However, there is no effort to judge the appropriateness of materials in terms of broader consumer concerns.

Biotechnology

Ingredients are more and more likely to be a product of biotechnology. The 1st and one of the most dramatic examples is the milk clotting enzyme chymosin. What are some of the issues? The 1st is the overall acceptability of the biotechnology concept. Much to the surprise of many, both the Muslim and Jewish leadership have accepted biotechnology products from currently used genetic modification technologies. In fact, many of the products are well liked by the religious leaders because, if made in a bioreactor with the right mix of ingredients, the halal or kosher status is much more easily established and maintained, and items that in the past were either difficult or expensive to get as kosher and/or halal are now readily available.

The 2nd issue is the one that has already been covered, namely, the bioreactor itself. And obviously any subsequent processing also needs to consider the processing system. But these are easily accomplished if the goal is to produce a kosher or halal product.

Flavors

Three flavors come from the slaughter of animals that are inherently nonkosher and nonhalal animals. These are civet (a secretion of the civet cat), castoreum (an extract of beaver glands), and ambergris (an extract of sperm whale intestines) (Lipschutz 1988). Thus, all prepared flavors, including both artificial and natural flavors with other natural flavors (abbreviated as WONF in the industry), need to be checked to be sure that none of these flavor compounds are used in the complex compounding that is so much a part of the modern flavor industry. Note that a true flavor, such as a strawberry flavor made only with components derived from strawberries would not have these prohibited materials. But very few flavors are prepared from only a single source. The question then is, could these 3 flavors be made using biotechnology so that they could be available for kosher and halal products?

Passover

The Jewish holiday of Passover, as previously mentioned, has many additional restrictions that have a strong impact on the acceptability for that holiday of many key ingredients in food products. During this period none of the year-round kosher laws are changed, but the use of the 5 prohibited grains (wheat, oat, rye, barley, and spelt) in any form other than unleavened bread

(matzos) and its derivatives after baking (matzos flour and matzos meal) is specifically prohibited. However, the rabbis of Europe also instituted additional restrictions on materials such as corn, rice, legumes, peanuts, buckwheat, and other materials that either could be made into flours or which grew naturally in fields where the prohibited grains might be growing. Although a few rabbis restrict this to only the solid form of these additional materials, most Orthodox rabbis also include liquid derivatives (such as corn syrup), with most rabbis also including chemical derivatives of corn syrup such as ascorbic acid (vitamin C) derived from the fermentation of corn syrup. So many products that are kosher all year-round become prohibited during the week of Passover. Thus, a special marking for products for Passover is used, most commonly the capital letter “P,” although it is also important to be sure that the “p” is a capital letter and that it means acceptable for Passover and not that the material is “pareve” (neutral, neither milk nor meat). Note that this restriction beyond the 5 originally prohibited grains occurred in Europe in the 1500s or so. Jews coming from the traditionally Muslim countries (Spain, North Africa, and the Middle East) do not observe these additional restrictions and more and more products (especially from Israel) may be marked as “can be used for Passover by those that accept kitnyos (additionally prohibited materials).” This is the term for the extensions to the prohibition of the 5 grains. It is also important to note that in Europe many of these compounds are actually made from wheat rather than corn, which makes it important to be aware of the use of such materials even for Jews from the Muslim countries. Starch in North America is most likely cornstarch, while starch in Europe may well be a wheat starch.

Summary

This paper is a discussion of some of the problems related to ingredients and processing aids used in the food industry and why these may make a product not kosher (treif) or not halal (haram). It should be clear that it is most important that people in the food industry interested in preparing kosher and/or halal foods understand these concerns and be prepared to work with the rabbis and Muslim religious leaders to deal with these issues to successfully make it possible for their products to be religiously certified. It should also be clear that the religious certification agencies have the important and sometimes difficult task of following all of the ingredients through all of their different manufacturing steps, often starting with production agriculture, even in developing countries, to determine the full history, such as full traceability, of the ingredients and products they are certifying. It is clear that the rabbis and Muslim certifiers are ahead of the secular authorities in establishing a system of traceability. Thus, a religious certification agency must determine the standards it will use to certify products with its trademarked symbol on it, and it must have the technical competence to truly assure that its standards are followed. The use of laboratory testing can then be used to supplement these on-the-ground activities to retain the integrity of the system as there is no way to assure continuous supervision for the vast array of materials flowing into the kosher and halal systems. On the

other hand, it is also clear that testing alone cannot be used and it only serves to reinforce the efforts of the religious supervisors. And, most importantly, it behooves the religious food consumer to first establish the standard that they intended and the family will follow, and to then only purchase goods prepared by religious supervision agencies that they have identified, often with the help of their local religious leaders. Although this sounds like a great deal of work, there are “general” standards at various levels of strictness that exist and religious leaders can guide their congregants to the trademarked symbols that serve their community. Obviously, the use of generic terms like “kosher,” “halal,” and the use of a nontrade marked symbol such as the unadorned letter “K,” which cannot be trademarked, all require the serious religious foods consumer to determine who is providing the certification. That requires homework and often the information obtained from the company and the religious supervision organizations not self-identified through a trademarked symbol can be difficult to obtain and may not always be reliable. Often the wording of a reply is ambiguous. If consumers are serious about commitment to kosher and halal, they have a responsibility to do the homework. Thus, consumers need to put more pressure on the kosher and halal marketing system to use trademarked symbols that represent an organization that the consumer can hold accountable and which provides both the companies and the consumer with confidence in the kosher and/or halal status of the products being offered in the marketplace.

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