

# Kosher and halal in the biotechnology era

Joe M Regenstein,<sup>1</sup> Muhammad M Chaudry,<sup>2</sup> Carrie E Regenstein<sup>3</sup>

<sup>1</sup>Cornell Kosher Food Initiative, Cornell University, Ithaca, NY, USA; <sup>2</sup>Islamic Food and Nutrition Council, Chicago, IL, USA; <sup>3</sup>Division of Information Technology, University of Wisconsin-Madison, Madison, WI, USA

**Abstract:** The kosher and halal food laws represent the food requirements of people of the Jewish and Muslim faiths, respectively. The kosher laws predominantly focus on the allowed animals, the removal of blood and the separation of milk and meat. Other kosher laws deal with the preparation of food, including plant products. There are special kosher laws for the eight-day festival of Passover. The halal laws regulate allowed animals and the removal of blood. Additionally, alcohol is prohibited, as well as other intoxicating drinks and drugs. Both kosher and halal regulatory systems have provisions for modern religious leaders to apply traditional religious laws to contemporary situations, eg in addressing biotechnology issues. Jewish religious leaders accept all current gene transfer reactions regardless of the source of the gene, believing that the product takes on the identity of the end product. Muslim religious leaders are currently reviewing issues related to the use of synthetic genes and genes obtained from non-halal animals. Other forms of gene transfer are accepted by the Muslim community.

**Keywords:** kosher, halal, biotechnology and religion, religious foods, Muslim, Islam, Jew

**Preliminary note:** The information in this paper is as accurate as possible (as of 1 April 2003). However, the final decision on any application of biotechnology to kosher and halal foods rests with the religious authorities providing supervision. The ruling of the religious authorities may differ from the information presented here.

## Introduction

The objective of this paper is to describe the kosher and halal laws as they operate in the food industry, particularly that of the United States, including adjusting to new technologies, especially biotechnology. To understand the impact of kosher and halal foods in the marketplace, one must have some understanding of how they are produced and how important kosher and halal compliance is to consumers.

## Kosher and halal laws

We will start by focusing on the religious significance of the dietary laws for Jews and Muslims.

### Kosher

The kosher dietary laws determine which foods are 'fit or proper' for consumption by Jewish consumers who observe these laws. The laws are biblical in origin, coming mainly from the original five books of the Holy Scriptures (the Torah). Jewish tradition teaches that at the same time Moses received the Ten Commandments on Mount Sinai, he also received the oral law, which was eventually written down many years later in the Talmud. This oral law is as much a part of biblical law as the written text. Over the years, the meanings of the biblical kosher laws have been interpreted and extended by the rabbis to protect the Jewish people from violating any of the fundamental laws, and to address new

issues and technologies. The system of Jewish law is referred to as *halacha*.

Why do Jews follow the kosher dietary laws? Many explanations have been given. The following explanation by Rabbi I Grunfeld summarises the most widely held ideas about the subject (Grunfeld 1972). Although this explanation is also relevant for halal, it is important to note that, unlike the kosher laws, the health aspects of food are an important consideration with the halal laws. The kosher laws are viewed by the Jewish community as given, without a need for explanation. Only in modern times have some people felt a need to try to justify them as health laws. For a discussion of why the kosher laws are not health laws, see Regenstein (1994).

'And ye shall be men of a holy calling unto Me, and ye shall not eat any meat that is torn in the field' (Exodus XXII:30). Holiness or self-sanctification is a moral term; it is identical with ... moral freedom or moral autonomy. Its aim is the complete self-mastery of man.

To the superficial observer it seems that men who do not obey the law are freer than law-abiding men, because they can follow their own inclinations. In reality, however, such men are subject to the most cruel bondage; they are

Correspondence: Joe M Regenstein, Cornell Kosher Food Initiative, Department of Food Science, Stocking Hall, Cornell University, Ithaca, NY 14853-7201, USA; tel +1 607 255 8041; fax +1 607 254 4868; email jmr9@cornell.edu

slaves of their own instincts, impulses and desires. The first step towards emancipation from the tyranny of animal inclinations in man is, therefore, a voluntary submission to the moral law. The constraint of law is the beginning of human freedom.... Thus the fundamental idea of Jewish ethics, holiness, is inseparably connected with the idea of Law; and the dietary laws occupy a central position in that system of moral discipline which is the basis of all Jewish laws.

The three strongest natural instincts in man are the impulses of food, sex, and acquisition. Judaism does not aim at the destruction of these impulses, but at their control and indeed their sanctification. It is the law which spiritualises these instincts and transfigures them into legitimate joys of life. (Grunfeld 1972, p 11–12. Copyright: with kind permission of The Soncino Press, Ltd.)

## Halal

The halal dietary laws determine which foods are ‘lawful’ or permitted for Muslims. These laws are found in the Quran and the books of Hadith (the Traditions). Islamic law is referred to as *Shari’ah* and has been interpreted by Muslim scholars over the years. The basic principles of the Islamic laws remain definite and unaltered. However, their interpretation and application may change according to time, place and circumstances. Besides two basic sources of Islamic law, the Quran and the Hadith, other sources of jurisprudence are used in determining the permissibility of food when a contemporary situation is not explicitly covered in the basic sources. The third source is called *Ijihad*, or to exert oneself fully to derive an answer to the problem. This could be accomplished by one or both of the following: (1) *ijma*, meaning consensus of opinion; (2) *qiyas*, meaning reasoning by analogy. Current issues of GMO (genetically modified organism) foods, animal feed and hormones are discussed in the light of these two concepts and several other lesser sources of Islamic jurisprudence.

Biotechnology, unconventional sources of ingredients, synthetic materials, and innovations in animal slaughter and meat processing are some of the issues Muslim scholars are dealing with in helping consumers make the right choices.

Why do Muslims follow the halal dietary laws? The main reason for the observance of the Islamic faith is to follow the Divine Orders: ‘O ye who believe! Eat of the good things wherewith WE have provided you, and render thanks to ALLAH if it is He whom ye worship’ (Quran 2:172). God reminds the believers time and again in the Holy Scripture to eat what is *Halal-un-Tayyaban* meaning ‘permitted, and good or wholesome’: ‘O, Mankind! Eat of that which is Lawful and Wholesome in the earth....’ (Quran 2:168). ‘Eat

of the good things. We have provided for your sustenance, but commit no excess therein’ (Quran 20:81).

Again in the Quran, in Chapter 6 titled ‘Cattle’, Muslims are ordained to eat the meat of animals upon which Allah’s name has been invoked. This is generally interpreted that an invocation has to be made at the time of slaughtering an animal: ‘Eat of that over which the name of Allah hath been mentioned, if ye are believers in His revelations’ (Quran 6:119). While Muslims eat what is permitted specifically or by implication or by omission and being silent about it, they avoid eating what is specifically disallowed, such as:

And eat not of that whereupon Allah’s name hath not been mentioned, for lo, It is abomination. Lo! The devils do inspire their minions to dispute with you. But if ye obey them, ye will be in truth idolaters. (Quran 6:122)

The majority of the Islamic scholars are of the opinion that this verse refers to the proper slaughtering of the allowed animals.

Since Muslim dietary laws relate to Divine permissions and prohibitions, if anyone observes these laws he/she is rewarded in the hereafter and if one violates these laws he/she may receive punishment accordingly. The rules for those foods that are not specifically prohibited may be interpreted differently by various scholars. The things that are specifically prohibited are just a few in number, summarised in the following verse:

Forbidden unto you are: carrion and blood and swine flesh, and that which hath been dedicated unto any other than Allah, and the strangled, and the dead through beating, and the dead through falling from a height, and that which hath been killed by the goring of horns, and the devoured of wild beasts saving that which ye make lawful, and that which hath been immolated to idols. And that ye swear by the divining arrows. This is abomination. (Quran 5:3)

Although these permissions and prohibitions are enough for a Muslim to observe the laws, it is believed that the dietary laws are based on health reasons due to the impurity or harmfulness of what they prohibit.

## The kosher and halal markets

Why are we concerned about kosher and halal in the secular world? Because both kosher and halal are important components of the food business. Most people are not aware of the breadth of foods that are under religious supervision. This section provides background on the economic aspects of both these markets. It is important for the food industry to better understand kosher and halal if they are to meet the needs of these valuable markets.

### The kosher market

The kosher market, according to Integrated Marketing, an advertising agency specialising in the kosher food industry, covers almost 100 000 products in the United States. In 2001, about US\$100 billion worth of products are estimated to have a kosher supervision marking on them. The deliberate consumers of kosher food, ie those who specifically look for the kosher mark, are estimated to be about 6–8 million Americans and they are purchasing almost US\$3–5 billion worth of kosher product annually. Others buy kosher products without even realising it. Fewer than one-third (possibly as low as one-quarter) of kosher consumers are Jewish; other consumers who at times find kosher products helpful in meeting their dietary needs include Muslims, Seventh Day Adventists, vegetarians, vegans, people with various types of allergies – particularly to dairy, grains and legumes – and general consumers who value the quality of kosher products, even though there is rarely a one-to-one correlation between kosher and these various consumers' needs. 'We report to a higher authority (Hebrew National)' and 'You don't have to be Jewish to love Levy's Rye Bread' are two of the more famous campaigns used to advertise kosher products to non-kosher consumers. AdWeek magazine called kosher 'the Good Housekeeping Seal for the 90s' (Lubinsky M, pers comm). By undertaking kosher certification, companies can incrementally expand their market by opening up new niche markets. This paper includes information that might assist kosher supervision agencies to address the specific needs of these other consumer groups.

With the agreement of the client company, kosher supervisors can address the needs of the non-Jewish markets. A document establishing preliminary guidelines for making kosher appropriate for all of the groups mentioned above without violating Jewish law has been prepared (Regenstein 2001) and serves as a basis for a multicultural kosher dining meal programme at Cornell University. Other universities are also exploring kosher/halal and multicultural options.

Although limited market data are available, the most dramatic data illustrating the impact of kosher certification in the marketplace has been provided by the Coors Brewing Company. According to their market analysis, their market share in the Philadelphia market went up 18% when the company went kosher and increased somewhat less – but still significantly – in other northeast markets in the United States. Dannon Yogurt (ie the American brand) experienced a growth in sales when it switched from a 'lenient' kosher certification (see below) to one that was normative mainstream (ie meets the normative, majority standards of the Orthodox

tradition; again, see below). A northeast soda bottling company let its kosher certification lapse, only to see a very marked drop in its sales. (The company quickly got re-certified.)

In recent years, many of the large national companies have gone kosher. For some, the effort has been quite extensive. For example, when Nabisco made many of its cookie products kosher, the process of equipment kosherisation (see below) took over three years before the company's many bakeries around the country were kosher and all of its kosher products could finally be marketed in the United States.

Of course, to consider whether a company wants to participate in the kosher (or halal) market, its leaders need to have some knowledge about the dietary laws themselves to determine profitability.

### The halal market

The Muslim market in North America is just developing. Over the past 30 years many halal markets and ethnic stores have sprung up, mainly in the major metropolitan areas. Most of the 6–8 million Muslims in North America observe halal laws (particularly the avoidance of pork) but the food industry has, for the most part, ignored this consumer group. Although there are excellent opportunities to be realised in the North American halal market, even more compelling opportunities exist on a worldwide basis as the food industry moves to a more global business model. The number of Muslims in the world is well over 1 billion. Many countries of South Asia, Southeast Asia, the Middle East and Northern Africa have predominantly Muslim populations. Although only about 15% of India's population is Muslim, it is the second largest Muslim country in the world after Indonesia. In many countries, halal certification has become necessary for products to be imported.

Although many Muslims purchase kosher food in the United States, these foods do not always meet the needs of the Muslim consumer. The most common areas of concern for the Muslim consumer when considering purchasing kosher products are the use of various questionable gelatins in products produced under more lenient kosher supervisions, and the use of alcohol as a carrier for flavours and as a food ingredient (these issues are discussed later in this paper).

## Kosher

### *Kosher dietary laws*

The kosher dietary laws predominantly deal with three issues, all focused on the animal kingdom:

1. Prohibited and permitted animals.
2. Prohibition of blood.
3. Prohibition of mixing of milk and meat.

Additionally, for the week of Passover (in late March or early April) restrictions on *chometz*, the prohibited grains (wheat, rye, oats, barley and spelt) – and the rabbinical extensions of this prohibition – lead to a whole new set of regulations, which are focused on the plant kingdom.

Ninety-two percent of American Jews celebrate Passover in some way, making it the most observed festival in the Jewish calendar. It also accounts for about 40% of the sales of kosher products to the Jewish community. (Although only 20%–33% of the kosher market in the United States is Jewish, these consumers account for over half of the total dollar volume of the kosher market, since they purchase kosher food more consistently.)

In this paper, we will also discuss additional laws dealing with special issues such as Jewish cooking and cheese making, Jewish supervision of milk, and equipment kosherisation.

### ***Allowed animals and prohibition of blood***

Ruminants with split hoofs that chew their cud, traditional domestic birds, and fish with fins and removable scales are generally permitted. Pigs, wild birds, sharks, dogfish, catfish, monkfish and similar species are prohibited, along with all crustacean and molluscan shellfish. Most insects are prohibited, such that carmine and cochineal (natural red pigments) are not used in kosher products.

With specific respect to poultry, the traditional domestic birds, ie chicken, turkey, squab, duck and goose, are kosher. Birds in the ratite category (ostrich, emu and rhea) are not kosher as the ostrich is specifically prohibited in the Torah. However, it is not clear whether the animal of the Torah is the same animal we know as an ostrich today. The ratites and most other birds are prohibited.

Ruminants and fowl must be slaughtered according to Jewish law by a specially trained religious slaughterman. These animals are subsequently inspected by rabbinically trained inspectors for various defects. In the United States, the desire for more stringent meat inspection requirements has led to the development of a kosher meat that meets a stricter inspection requirement, mainly with respect to the lungs, referred to as *glatt* (smooth) *kosher*. *Glatt* kosher would be considered for red meats where lung adhesions may be a problem (these often make an animal not kosher, or *treif*). In general, a *glatt* kosher animal's lungs have less than two such adhesions.

The meat and poultry must be further prepared by properly removing certain veins, arteries, prohibited fats, blood and the sciatic nerve. In practical terms this means that only the front quarter cuts of red meat are generally used. To remove the blood, red meat and poultry are soaked and salted within a specified time period after animal slaughter.

Materials that are derived from animal sources are often prohibited because of the difficulty of obtaining them from kosher animals. Thus, many products that might be used in the food industry, such as emulsifiers, stabilisers and surfactants, particularly those that are fat-derived, need careful rabbinical supervision to ensure that no non-kosher animal-derived ingredients are used. Almost all such materials are also available in a kosher form derived from plant oils.

### ***Prohibition of mixing of milk and meat***

'Thou shalt not seeth the kid in its mother's milk.' This passage appears three times in the Torah and is therefore considered a very serious admonition. The meat side of the equation has been rabbinically extended to include poultry because of its similarity to red meat and because it, too, requires religious slaughter. The dairy side includes all milk derivatives.

To keep meat and milk separate requires that the processing and handling of all products that are kosher falls into one of three categories: (1) meat products, (2) dairy products, and (3) *pareve* (*parve*) or neutral products. The latter includes all products that are not classified as meat or dairy. All plant products along with eggs, fish, honey and lac resin (shellac) are *pareve*. These *pareve* foods can be used with either meat products or dairy products, except that fish cannot be mixed directly with meat. Once a *pareve* product is mixed with either meat or dairy products, it takes on the status of meat or dairy, respectively.

Some kosher-observant Jews are concerned with the possible adulteration of kosher milk with the milk of other animals (eg mare's milk) and as such require that the milk be watched from the time of milking. This *cholev yisroel* milk and products derived from it are required by some of the stricter agencies effecting kosher supervision for all dairy ingredients.

To ensure the complete separation of milk and meat, all equipment and utensils must be of the proper category. Thus, if plant materials (eg fruit juice) are run through a dairy plant, the product would be considered a dairy product, even though it contains no dairy ingredients. Some kosher supervision agencies do permit such a product to be listed as 'dairy

equipment' or 'DE' rather than 'dairy'. With the DE listing, the consumer can use the product immediately after a meat meal, while a significant wait would be required to use a product with a dairy ingredient. In either case, the consumer would change from their meat set of dishes to their dairy set of dishes. There are a few products with no meat ingredients that are made in a meat plant (eg a split pea soup); again they may be marked 'meat equipment' or 'ME'.

Kosher-observant Jews must wait a fixed time between meat and dairy consumption. Customs vary but generally the wait after meat consumption before consuming dairy is much longer (3–6 h) than the wait from dairy to meat (0–1 h). However, when a hard cheese (defined as a cheese that has been aged for over 6 months) is eaten, the wait is the same as if it were meat. Thus, most companies producing cheese for the kosher market age their cheese for less than 6 months.

If one wants to make the product truly pareve, the processing plant can usually be made pareve by the process of equipment kosherisation (see below). From a marketing perspective, a pareve designation is most desirable.

## Passover

During this festival, all products made from chometz (the five prohibited grains: wheat, rye, oats, barley and spelt) cannot be used except in the specially supervised production of unleavened bread (*matzo*) that is prepared for the festival. Special care is taken to ensure that the matzos do not have any time to 'rise'. In addition, products derived from corn, rice, legumes, mustard seed, buckwheat and some other plants (*kitnyos*) are prohibited. Thus, items like corn syrup and cornflour are prohibited. Some rabbis, however, permit the oil from kitnyos materials and some permit liquid kitnyos products such as corn syrup. The major sweeteners and starches generally used for the production of 'sweet' Passover items are either real sugar (cane or beet sugar) or potato-derived products. Some potato syrup is also used.

Passover is a time of large family gatherings. However, because of the need for separate dairy and meat dishes for Passover, some kosher consumers may not use any dairy products and will only have a special Passover set of meat dishes rather than both. Overall, 40% of kosher sales for the traditional 'kosher' companies occur during the week of Passover. Consumers using products on a regular basis are concerned about being able to obtain a 'Passover-acceptable' version of their favourite product, including those products made via biotechnology processes.

## Equipment koshering

There are three ways to make equipment kosher and/or to change its status. Which procedure is required depends on the equipment's prior production history. Note that after a plant (or a line) has been used to produce kosher pareve products, it can be switched to either kosher dairy or kosher meat without special equipment kosherisation.

The simplest kosherisation of equipment occurs with equipment made of materials that *can* be koshered and that have been handled only when cold. These require a good caustic/soap cleaning. However, materials such as ceramics, rubber, earthenware and porcelain cannot be koshered. If these materials are found in a processing plant, new materials may be required for production and switching between the different status conditions will be difficult.

Most food processing equipment is usually operated at cooking temperatures, generally above 49 °C (120 °F), which is defined rabbinically as 'cooking'. However, the exact temperature for 'cooking' depends on the rabbi, although an agreement by the four major American kosher certifying agencies has settled on 49 °C (120 °F) as the temperature at which foods are cooked. Koshering items that have been used to make non-kosher cooked products (ie products that are heated to above 49 °C) or kosher dairy products, when a pareve production is needed, involves thorough cleaning of the processing equipment with caustic/soap (as would normally be used in a food plant). The processing equipment must then be left idle for 24 h and finally the equipment must be flooded with boiling water (defined as water heated to between 88 °C (190 °F) and 100 °C (212 °F)) in the presence of a kosher supervisor.

In the case of ovens or other equipment that use 'fire', kosherisation involves heating the metal until it glows. Again, a rabbi will generally be present while this process is taking place.

The procedures that must be followed for equipment kosherisation can be quite extensive, so that the fewer conversions of status the equipment undergoes, the better. Careful formulating of products and good production planning can minimise the inconvenience.

## Jewish cooking

Depending on what is being cooked, it may be necessary for a rabbi to 'do' the cooking. In practical terms this is often accomplished by having a rabbi light the pilot light, which is then left on continuously.

In the case of cheese making, a similar concept usually requires a rabbi to add the coagulating agent into the vat.

However, if the ingredients used during cheese making are all kosher and the equipment is kosher, but a rabbi has not added the coagulant, then the whey derived from such cheese (as long as the curds and whey have not been heated above 49 °C before the whey is drained off) would be considered kosher. However, the cheese itself would not be acceptable as kosher because no rabbi added the coagulant or was present during its addition. Thus, there is much more kosher whey available than kosher cheese. Whey cream is obtained by taking whey and spinning off the remaining cream. In recent years, the presence of whey cream in the marketplace and its use in butter have made butter an item that now requires kosher supervision (Regenstein and Regenstein 2002a, 2002b, 2002c). This change has been very disruptive in the marketplace. If the whey is obtained above 49 °C, eg from Swiss or Emmenthal cheese, then the whey is not kosher and neither is the whey cream derived from it. As a consequence, the whey would now be subject to the rule requiring the presence of a rabbi when the coagulant is added.

## Halal

### *Halal dietary laws*

The halal dietary laws deal with the following four issues, of which all except one are in the animal kingdom.

1. Prohibited and permitted animals.
2. Method of slaughtering.
3. Prohibition of blood.
4. Prohibition of intoxicants.

There are eleven generally accepted principles pertaining to halal (permitted) and *haram* (prohibited) consumption in Islam, providing guidance to Muslims in their customary practices.

1. The basic principle is that all things created by Allah are permitted, with a few exceptions that are prohibited. Those exceptions include pork, blood, the meat of animals that died of causes other than proper slaughtering, food that has been dedicated or immolated to someone other than Allah, alcohol and intoxicants.
2. To make lawful and unlawful is the right of Allah alone. No human being, no matter how pious or powerful, may take it into his hands to change it.
3. Prohibiting what is permitted and permitting what is prohibited is similar to ascribing partners to Allah. This is a sin of the highest degree that makes one fall out of the sphere of Islam.
4. The basic reasons for the prohibition of things are due to their impurity and harmfulness. A Muslim is not supposed to question exactly why or how something that Allah has

prohibited is unclean or harmful; there might be obvious reasons and there might be obscure reasons. To a person of scientific mind, some of the obvious reasons could be as follows:

- Carrion and dead animals are unfit for human consumption because the decay process leads to the formation of chemicals harmful to humans.
- Blood that is drained from an animal contains harmful bacteria, products of metabolism and toxins.
- Swine serve as a vector for pathogenic worms to enter the human body. Infections by *Trichinella spiralis* and *Taenia solium* are not uncommon.
- Intoxicants are considered harmful to the nervous system, affecting the senses and human judgement, thus leading to social and family problems and in many cases even death.
- Immolating food to someone other than Allah may imply that there is somebody as important as Allah, that there could be two Gods. This would be against the first tenet of Islam: 'THERE IS BUT ONE GOD' (Quran 47:19).

These reasons and explanations, and many more like these, may be acceptable as being sound arguments, but the underlying principle behind the prohibitions remains the Divine Order: 'FORBIDDEN UNTO YOU ARE....' (Quran 5:3).

5. What is permitted is sufficient; what is prohibited then is superfluous. Allah prohibited only things that are unnecessary or dispensable, while providing better alternatives. People can survive and live better without consuming alleged unhealthy carrion, unhealthy pork, unhealthy blood and the root of most vices, alcohol.
6. Whatever is conducive to the 'prohibited' is in itself prohibited. If something is prohibited, anything leading to it is also prohibited.
7. Falsely representing unlawful as lawful is prohibited. It is unlawful to make flimsy excuses and consume something which is prohibited, such as drinking alcohol for supposedly medical reasons.
8. Good intentions do not make the unlawful acceptable. Whenever any permissible action of the believer is accompanied by a good intention, his action becomes an act of worship. In the case of haram, it remains haram, no matter how good the intention or how honourable the purpose may be. Islam does not endorse employing a haram as a means to achieve a praiseworthy end. Islam indeed insists that not only the goal be honourable, but also that the means chosen to achieve it be lawful and

proper. Islamic laws demand that the right should be secured through just means only.

9. Doubtful things should be avoided. There is a grey area between the clearly lawful and the clearly unlawful. This is the area of 'what is doubtful'. Islam considers it an act of piety for Muslims to avoid doubtful things, for them to stay clear of the unlawful. Prophet Muhammad said:

The halal is clear and the haram is clear. Between the two there are doubtful matters concerning which people do not know whether they are halal or haram. One who avoids them in order to safeguard his religion and his honor is safe, while if someone engages in a part of them, he may be doing something haram. (Sakr 1996, p 26–7)

10. Unlawful things are prohibited to everyone alike. Islamic laws are universally applicable to all races, creeds and sexes. There is no favoured treatment of a privileged class. Actually, in Islam, there are no privileged classes; hence, the question of preferential treatment does not arise. This principle applies not only among Muslims, but between Muslims and non-Muslims as well.
11. Necessity dictates exceptions. The range of prohibited things in Islam is quite limited, but emphasis on observing the prohibitions is very strong. At the same time, Islam is not oblivious to the exigencies of life, to their magnitude, or to human weakness and incapacity to face them. A Muslim is permitted, under the compulsion of necessity, to eat a prohibited food in quantities sufficient to remove the necessity and thereby survive.

### ***Prohibited and permitted animals***

Meat of pigs, boars and swine is strictly prohibited, and so is the meat of carnivorous animals such as lions, tigers, cheetahs, dogs and cats, and of birds of prey like eagles, falcons, osprey, kites and vultures.

Meat of domesticated animals like ruminants with split hoofs – eg cattle, sheep, goat, lamb – is allowed for food, as is the meat of camels and buffaloes. Also permitted are the birds that do not use their claws to hold down food, such as chickens, turkeys, ducks, geese, pigeons, doves, partridges, quails, sparrows, emus, ostriches and the like. Some of the animals and birds are permitted only under special circumstances or under certain conditions. Horsemeat may be consumed under some distressing conditions, the discussion of which is beyond the scope of this paper. Animals fed unclean or filthy feed, eg sewage or rendering by-products, must be fed clean feed for 3–40 days before slaughter to cleanse their systems.

Foods from the sea – namely, fish and other seafood – are the most controversial among various denominations of Muslims. Certain groups accept only fish with scales as halal, while others consider everything that lives in water all the time or some of the time as halal. Consequently, prawns, lobsters, crabs and clams are halal but may be detested (*makrooh*) by some, and hence not consumed. Animals that live both in water and on land (amphibians) such as frogs, turtles, crocodiles and seals are also not consumed by most Muslims.

The status of insects is not clearly established in Islam except that the locust is specifically mentioned as halal. Insects, in general, are considered neutral. However, from deduction of the laws, it seems that helpful insects like bees and ants, and the beneficial spiders, or harmful or dirty creatures like lice, flies and mosquitoes may also be prohibited as food. Among the by-products from insects, honey was very highly recommended by the Prophet Muhammad. Other products like royal jelly, wax, shellac and carmine are acceptable for use without restrictions by most Muslims, but some may consider shellac and carmine *makrooh* or offensive to their psyche.

Eggs and milk from permitted animals are also permitted for Muslim consumption. Milk from cows, goats, sheep and buffaloes is halal. Unlike the kosher laws, there is no restriction on mixing meat and milk.

### ***Prohibition of blood***

According to the Quranic verses, blood that pours forth is prohibited from being consumed. This includes blood of permitted and non-permitted animals alike. Liquid blood is generally not offered for sale or consumed even by non-Muslims, but products made with, and from blood, are available. There is general agreement among Muslim scholars that anything made from blood is unacceptable. Products like blood sausage and ingredients like blood albumin are either haram or questionable at best, and should be avoided for product formulations.

### ***Proper slaughtering of permitted animals***

There are special requirements for slaughtering an animal: the animal must be of a halal species; it must be slaughtered by an adult and sane Muslim; the name of Allah must be pronounced at the time of slaughter; and slaughter must be done by cutting the throat in a manner that induces rapid and complete bleeding, resulting in the quickest death. The generally accepted method is to cut at least three of the four

passages, ie carotid arteries, jugular veins, trachea and oesophagus. The meat of animals thus slaughtered is called *zabiha* or *dhabiha* meat.

Although kosher meat is slaughtered using the same principles, a prayer is not said over each animal at the time of slaughter. Thus, many Muslim scholars do not accept kosher meat as halal. However, in the absence of available halal meats, individual Muslims may choose to purchase kosher meat products.

Islam places great emphasis on the gentle and humane treatment of animals, especially before and during slaughter. Some of the conditions include giving the animal proper rest and water, avoiding conditions that create stress, not sharpening the knife in front of the animals and using a very sharp knife to slit the throat. After the blood has been allowed to drain completely from the animal and the animal has become lifeless, only then may the dismemberment (eg cutting off of horns, ears, legs) commence. Unlike for kosher meat, soaking and salting of the carcass is not required for halal. Hence, halal meat is treated no differently than commercial meat. Animal-derived food ingredients like emulsifiers, tallow and enzymes must be made from animals slaughtered by a Muslim to be halal.

Hunting of permitted wild animals like deer, and birds like doves, pheasants and quail, is permitted for the purpose of eating but not for merely deriving pleasure out of killing an animal. Hunting by any means and with any tools (like guns, arrows, spears or trapping) is permitted. Trained dogs may also be used for catching or retrieving the quarry. The name of Allah may be pronounced at the time of ejecting, firing or launching the tool rather than at the catching of the quarry. The animal has to be bled by slitting the throat as soon as it is caught. If the blessing is made at the time of pulling the trigger or shooting an arrow and the hunted animal dies before the hunter reaches it, it would still be considered halal as long as some blood comes out during slaughter. Fish and seafood may be hunted or caught by any reasonable means available, as long as it is done humanely, and need not be ritually slaughtered. There is no special method of killing the locust. Hunting during the pilgrimage to Makkah and within the defined boundaries of the holy city of Makkah is strictly prohibited.

The meat of animals that die of natural causes or diseases, from being gored by other animals, by being strangled, by falling from a height, through beating or that were killed by wild beasts, cannot be eaten lawfully unless one slaughters the animal before it actually becomes lifeless. A fish that

dies of itself, is floating on water or is lying out of water is still halal as long as it does not show any signs of decay or deterioration.

An animal must not be slaughtered in dedication to someone other than Allah, nor immolated to anybody other than Allah under any circumstances. This is a major sin.

### ***Prohibition of alcohol and intoxicants***

Consumption of alcoholic drinks and other intoxicants is prohibited according to the Quran (5:90–91), as follows:

O you who believe! Strong drinks and games of chance, and idols and divining arrows are only an infamy of Satan's handiwork. Leave it aside in order that you may prosper. Only would Satan sow hatred and strife among you, by alcohol, and games of chance, and turn you aside from the remembrance of Allah, and from prayer: Will you not, therefore, abstain from them?

The Arabic term used for alcohol in the Quran is *khemr*, meaning that which has been fermented, and applies not only to alcoholic beverages like wine, beer, whiskey and brandy, but to all things that intoxicate or affect one's thought processes. Although added alcohol is prohibited in any beverages, like soft drinks, a small amount of alcohol contributed from food ingredients may be considered an impurity and hence ignored. Synthetic or grain alcohol is permitted in food processing for extraction, precipitation, dissolving and other reasons, provided the amount of alcohol remaining in the final product is very small, generally below 0.1%. However, each importing country may have its own guidelines which must be understood by the exporters and strictly followed.

### ***Halal cooking, food processing and sanitation***

There are no restrictions about cooking in Islam, as long as the kitchen is free from haram foods and ingredients. For example, there is no need to keep two sets of utensils, one for meat and the other for dairy, as in kosher food preparation. Alcohol may not be used, even in cooking.

In food companies, haram materials should be kept segregated from halal materials. The equipment used for non-halal products has to be thoroughly cleaned using proper techniques with acids, bases, detergents and hot water. As a general rule, kosher clean-up procedures would be adequate for halal. If the equipment is used for haram products, it must be properly cleaned, sometimes by using an abrasive

material, and then be blessed by a Muslim inspector who rinses it with hot water seven times.

## Dealing with kosher and halal supervision agencies

In practical terms, the food industry works with kosher and halal supervision agencies to obtain permission to use the trademark symbol of the agency on its products. In this way, the industry can make claims in the marketplace that are legal and, more importantly, credible to those intentionally purchasing these products. Providing consumers with this choice can be a significant potential opportunity. Kosher or halal supervision is undertaken by a company to expand its market opportunities. It is a business investment which, like any other investment, must be examined critically in this era of 'total quality management', 'just-in-time production' and 'strategic suppliers'.

What criteria should a company use to select a supervision agency? Supervision fees must be taken into account, and recognition of the agency's name is a consideration. Other important considerations include: (1) responsiveness in handling paperwork, in providing *mashgiachs* (koshering supervisors) or Muslim inspectors at the plants as needed and in doing routine inspections at a defined frequency during the year (anywhere from twice a year to every day (including continuous), depending on the nature of the production); (2) willingness to work with the company on problem solving; (3) ability to clearly explain their kosher or halal standards and their fee structure. And, of course, one should consider (4) if the 'personal' chemistry is right and (5) if the agency's religious standards meet the company's needs in the marketplace.

One of the hardest issues for the food industry to deal with in day-to-day kosher activities is the existence of so many different kosher supervision agencies. Halal has fewer agencies but still has many standards. How does this impact on the food companies? How do the Jewish kosher or Muslim halal consumers perceive these different groups? Because there has not been a central ruling authority for many years in either religion, different rabbis and Muslim inspectors follow different traditions with respect to the dietary standards they enforce. Some authorities tend to follow more lenient standards, while others follow more stringent ones. The trend in the mainstream kosher community today is towards a more stringent standard (some of the previous leniencies were undesirable but were tolerated because fewer alternatives were available). The mainstream Muslim

community also seems to be moving towards tighter standards so that approved products are acceptable to a larger audience.

One can generally divide the American kosher supervision agencies into three broad categories. First, there are the large organisations that dominate the supervision of larger food companies: the OU, the OK, the Star-K and the Kof-K; all four of which are nationwide and mainstream. Two of these, the OU and the Star-K, are communal companies, ie they are part of a larger community religious organisation. This provides them with a wide base of support, but also means that they may be subject to the other priorities and needs of their organisation. On the other hand, the Kof-K and the OK are private companies. Their only function is to provide kosher supervision. In addition to these national companies, there are smaller private organisations and many local community organisations that provide equivalent religious standards of supervision. The mainstream kosher supervision organisations will almost always accept each others' kosher products. The local organisations may have a bigger stake in the local community and may be more accessible and easier to work with. Although often having less technical expertise, they may be backed up by one of the national organisations.

For a smaller company marketing nationally, a limitation to sales may be that a consumer elsewhere in the United States may not know nor recognise their kosher symbol. With the advent of KASHRUS magazine (Yeshiva Birkas Reuven publisher, Brooklyn, New York) and its yearly review of symbols, this has become somewhat less of a problem. Note that KASHRUS magazine does not try to evaluate the standards of the various kosher supervision agencies, but simply reports of their existence. It is the responsibility of the local congregational rabbis to inform their congregation of their standards. Local rabbis who do not know enough about a distant organisation may be uncomfortable recommending it.

The second category of kosher supervision includes individual rabbis, generally associated with the Hassidic communities, ie groups with standards beyond the normative Orthodox standard. These are often affiliated with the ultra-Orthodox communities of Williamsburg and Borough Park in Brooklyn and Monsey, New York, and Lakewood, New Jersey. There are special food brands that cater to their needs. Many of the products used in these communities require continuous rabbinical supervision rather than the occasional supervision used by the mainstream organisations. The

symbols of the kosher supervisory agencies representing these consumers are not as widely recognised beyond these communities as those of the major mainstream agencies. The rabbis will often do special supervisions of products using a facility that is normally under mainstream supervision – often without any changes, but sometimes with special needs for their custom production.

The third level is individual rabbis that are more ‘lenient’ than the mainstream standard. Many of these rabbis are Orthodox; some may be Conservative. Their standards are based on their interpretation of the kosher laws. Employing a more lenient rabbi means that the food processor cuts out more of the mainstream and stricter markets; this is a retail marketing decision that each company needs to make for itself.

In the United States, the Muslim community has only one mainstream agency at this time, the Islamic Food and Nutrition Council of America (IFANCA). Other groups are entering the field, but their standards are not as well defined. Some groups and individuals have resorted to certifying their own products.

Companies will have to pay increasingly more attention to halal standards. Usually a few changes make it possible to permit kosher products to also serve the halal community, eg if they ensure the true absence of animal products (see below for a few kosher exceptions) and that any residual alcohol in products is below 0.1%. Again, producing products to a standard acceptable in all or most Muslim countries is desirable if marketing opportunities are to be maximised.

Ingredient companies should try to use a mainstream kosher supervision agency so that companies producing kosher food will purchase their products. The ability to sell to as many customers as possible requires a broadly acceptable standard. Unless an ingredient is acceptable to the mainstream, it is almost impossible for the kosher food producer to gain the benefit of having a kosher ingredient. In a few circumstances, if the company makes a product that would not be acceptable to the mainstream kosher supervision agencies under any circumstances, then the company may choose to use one of the more ‘lenient’ kosher supervision agencies willing to recognise that ingredient.

There is some amount of interchangeability between kosher supervision agencies. A system of certification letters is used to provide information from the certifying rabbi concerning the products he has approved. The supervising rabbi certifies that a particular plant produces kosher products, or that only products with certain labels or codes are kosher under his supervision. To prevent fraud, it is helpful if these letters are renewed every year and dated with

both a starting and ending date. These letters are the mainstay of how companies establish the kosher status of ingredients as the ingredients move in commerce. Consumers may also ask to see such letters. Obviously, a kosher supervision agency will only ‘accept’ letters from agencies they consider reputable.

In addition, the kosher or halal symbol of the certifying agency or individual doing the certification may appear on the packaging. (In some industrial situations, where kosher and non-kosher products are similar, some sort of colour-coding of products may also be used.) Most of these symbols are trademarks that are duly registered. However, in a few cases, the mark is not registered and more than one rabbi has been known to use the same kosher symbol.

There are three additional considerations for kosher and halal markings on products:

1. To ensure that labels on kosher foods are marked correctly, it is the responsibility of a food company to show its labels to its certifying agency prior to printing them. This responsibility includes both the agency symbol and the documentation establishing its kosher status, eg dairy or pareve for most dairy plant items. Many agencies currently do not require that ‘pareve’ be marked on products; others do not use the ‘dairy’ marking. This causes consumer confusion, which could be avoided if every kosher product had its status marked. Besides providing the proper information, it might encourage proper marking on products and avoid recalls and announcements of mislabelled products.
2. The labels for private label kosher products with specific agency symbols on their labels cannot be moved easily between plants. This is why some companies, those using private label and other companies, use the generic ‘K’. Thus, if the kosher supervision agency changes, the label can still be used. The sophisticated kosher consumer, however, is more and more uncomfortable with this symbol. By paying for a ‘good’ symbol and then only using the ‘K’, a company dilutes the value of its investment in kosher certification. In particular, if a company uses the ‘K’, the customer service and sales departments – and those people representing the company at trade shows – need to know who the certifying rabbi is.
3. In many Muslim countries a generic halal symbol, ie the word ‘halal’ in Arabic in a circle, has been used indiscriminately. Muslim consumers do not have much faith in such a symbol. In North America, some small companies have used similar generic markings, or just

the word 'halal' or letter 'H', to signify that food is halal but such symbols are not widely accepted. The IFANCA uses a registered trademark logo of the letter 'M' inside a closed crescent. Another agency, the Muslim Consumer Group, uses a triangle containing 'H' as its logo. Many other halal logos have started to appear on North American packaging, usually of imported foods. Indonesia, Malaysia, Singapore and Thailand have central halal control bodies, each with their own unique logo. As the volume of halal products, both local and international, offered in the marketplace grows, it is expected that determining the standards for a halal certification will become more complex.

## Gelatin

Important in many food products, gelatin is probably the most controversial of all modern kosher and halal ingredients. Gelatin can be derived from pork skin, beef bones or beef skin. In recent years, some fish gelatins have also appeared. The first author is currently involved in research in this area. As a food ingredient, fish gelatin has many similarities to beef and pork gelatin, ie it can have a similar range of bloom strengths and viscosities. However, depending on the species from which the fish skins are obtained, its melting point can vary over a much wider range than those of beef or pork gelatins. This may offer some unique opportunities to the food industry, especially for ice cream, yogurt, dessert gels, confections and imitation margarine. Fish gelatins would be fully kosher and halal, and acceptable to almost all of the mainstream religious supervision organisations. Also, a biotechnology-derived gelatin has been announced (see biotechnology discussion below for associated issues).

Currently available gelatins, even if called 'kosher', are not acceptable to the mainstream kosher supervision organisations. Many are, in fact, totally unacceptable to halal consumers because the gelatins may be pork-based. However, recently, a gelatin made from the hides of kosher slaughtered cattle has been available in limited supply at great expense, and this has been accepted by the mainstream and even some of the stricter kosher standards. The company manufacturing this gelatin produces it in different bloom strengths and also produces soft and hard capsules of various sizes. This is an important new development. Similarly, at least two major manufacturers are currently producing certified halal gelatin from cattle bones of animals that have been slaughtered by Muslims. Halal-certified hard and soft gelatin capsules are available at competitive prices. Several nutritional supplement manufacturers are already marketing

these products to a number of halal markets. Vegetarian capsules made with starch, cellulose or other vegetable ingredients are also available.

One finds a wide range of attitudes towards gelatin among the lenient kosher supervision agencies. The most liberal view holds that gelatin, being made from bones and skin, is not being made from a food (flesh). Further, the process used to make the product goes through a stage where the product is so 'unfit' that it is not edible by humans or dogs and, as such, becomes a new entity. Rabbis holding this view even accept pork gelatin. Most gelatin desserts with a generic 'K' fall into this category.

Other rabbis permit only gelatin from beef bones and hides, and not pork. Still other rabbis only accept 'India dry bones' as a source of beef gelatin. These bones, found naturally in India (because of the Hindu custom of not using cattle), are aged for over a year and are 'dry as wood'; additional religious laws exist for permitting the use of these materials. Again, none of these products are accepted by the mainstream kosher or halal supervision agencies and are therefore not accepted by a significant part of the kosher and halal communities.

## Biotechnology

Rabbis and Islamic scholars currently accept products made by simple genetic engineering. For example, genetically engineered chymosin (rennin) was accepted by rabbis about half a year before it was accepted by the US FDA (Food and Drug Administration) in 1990. The kosher basis for this decision involves the fact that the gene isolated from a non-kosher source is far below 'visible'. Subsequently, it is copied many times 'in vitro' and eventually injected into a host that is then reproduced many times. Thus, the original source of the 'gene' is essentially totally lost by the time the food product appears in the marketplace. This logic has served as the basis for the current acceptance of most biotechnology products. The production conditions in the fermenters must be kosher or halal; ie the ingredients, fermenter and any subsequent processing must use kosher or halal equipment and ingredients of the appropriate status. A product produced in a dairy medium, eg extracted from cow's milk, would be considered dairy. Mainstream rabbis may approve porcine lipase made through biotechnology when it becomes available, if all the other conditions are kosher. The Muslim community is still considering the issue of products containing an actual porcine gene. Although a final ruling has not been established, the leaning seems to be towards rejecting such materials. If the gene for a porcine product

were synthesised in a laboratory using strictly halal ingredients and equipment, ie it did *not* come directly from a pig, Muslim leaders are still considering whether the product should be accepted or not. The religious leaders of both communities have not yet determined the status of more complex genetic manipulations; such a discussion is therefore premature.

## Federal and state regulations

Making a claim of kosher on a product is a 'legal' claim in the United States. The Code of Federal Regulations (21CFR101.29; United States Government Printing Office 1996) has a paragraph indicating that such a claim must be appropriate, and approximately 20 states, some counties and some cities have laws specifically regulating the claim of 'kosher'. Many of these laws refer to 'Orthodox Hebrew Practice' or some variant of this term and their legality in the 1990s has been subject to further court interpretation. Note that recent court rulings in New Jersey and Baltimore, New York, have both thrown out secular kosher laws for violating the First Amendment's separation of church and state clauses.

New York State probably has the most extensive set of state kosher laws. These laws, however, were declared unconstitutional in August 2000 by the Federal District Court for Eastern New York, sustained by the Court of Appeals for the Second District and an en banc request for rehearing by the Second District was denied. An appeal to the United States' Supreme Court has been unsuccessful and the law is now considered 'unconstitutional'. Efforts to create a new kosher (and, possibly, halal) law for New York State are now taking place. The original law includes a requirement to register kosher products with the Kosher Enforcement Bureau of the Department of Agriculture and Markets.<sup>1</sup> This part of the law was not declared unconstitutional and is still being enforced.

The State of New Jersey has relatively new kosher laws – because the State's original laws were declared unconstitutional by the State Supreme Court – that probably have the clearest focus and, it is hoped, no constitutional issue. They focus specifically on 'consumer right to know' issues and 'truth in labelling'. The regulations avoid having the State of New Jersey define kosher. Rather, the rabbis providing supervision declare the information that consumers need to make an informed decision. In July 2000, New Jersey passed a bill extending the same protection to the Muslim community.

If American states are to provide assistance in assuring that kosher and halal products are honestly presented in the marketplace, we anticipate that laws closer to those of New Jersey will be needed. It also seems appropriate that such marketplace protection be offered in each state for both kosher and halal products. In addition to New Jersey, the states of California, Illinois, Minnesota and Michigan have recently passed a halal law.

## Kosher and allergies

Many consumers use the kosher markings as a guideline for determining whether products might meet their special needs (including allergies). There are, however, limitations that the particularly sensitive consumer needs to keep in mind, and the two most important are discussed below.

1. A process of equipment kosherisation is used to convert equipment from one status to another. This is a well-defined religious procedure, but may not lead to 100% removal of previous materials run on or through the equipment.
2. Kosher law does permit certain after-the-fact errors to be negated. Thus, trace amounts (less than one-sixtieth by volume under very specific conditions) can be nullified. Many kosher supervision agencies, in deference to a company's desire to minimise negative publicity, do *not* announce when they have used this procedure to make a product acceptable.

Products that one might expect to be made in a dairy plant, eg pareve substitutes for dairy products and some other liquids like teas and fruit juices, may be produced in plants that have been kosherised, but may not meet a very strict allergy standard. Another product that can be problematic is chocolate; many plants make both milk chocolate and pareve chocolate. Getting every last trace of dairy product out of pareve chocolate can be difficult. In terms of dairy and meat equipment, if there are no intentional added dairy or meat ingredients, but the product was produced on a dairy or meat line without any equipment kosherisation, the product is considered pareve with some use restrictions in a kosher home. In a few instances, where pareve or dairy products contain small amounts of fish (eg anchovies in Worcestershire sauce), this ingredient *may* be marked as part of the kosher supervision symbol. However, many certifications do not specifically mark this.

At Passover, there is some dispute about 'derivatives' of both chometz and kitnyos materials. A few rabbis permit items like corn syrup, soybean oil, peanut oil and similarly

derived materials from these extensions. The 'proteinaceous' parts of these materials are generally not used. Consumers with allergies to these items can therefore purchase these special Passover products from supervision agencies that do *not* permit kitnyos derivatives. With respect to 'equipment kosherisation', supervising rabbis tend to be very strict about the clean-up of the prohibited grains, so these Passover products come closest to meeting potential allergy concerns; this may not be the case with respect to the kitnyos prohibitions. Consumers should not assume that kosher markings ensure the absence of trace amounts of the ingredient to which they are allergic.

How thoroughly can a dairy product be kept out of a pareve product line? The current standard for kosher may not meet the needs of allergic consumers. Is the dairy powder dust in the air sufficient to cause problems? A company might choose to use a special marking on kosher pareve chocolates produced on lines that also produce dairy products to indicate that these are religiously pareve, but they may not be sufficiently devoid of dairy allergens for very allergic consumers. Furthermore, consumers may also want to consider testing the chocolate using one of the modern antibody or similar types of tests. For example, Regular M&Ms are marked as 'containing peanuts' to alert people who are very allergic to peanuts. The product does not contain peanuts, but common equipment (although cleaned between product runs) is used for this product and for Peanut M&Ms.

## Conclusion

The kosher and halal dietary laws are an important part of the food industry. As new technology develops, including biotechnology, the rabbis and Muslim leaders must be kept informed and will be required to determine the acceptability of these processes.

## Notes

- <sup>1</sup> Kosher Enforcement Bureau, Department of Agriculture and Markets, 55 Hanson Pl, Brooklyn, NY 11217, USA.

## References and additional readings

- Chaudry MM. 1992. Islamic food laws: philosophical basis and practical implications. *Food Technol*, 46(10):92.
- Chaudry MM, Regenstein JM. 1994. Implications of biotechnology and genetic engineering for kosher and halal foods. *Trends Food Sci Technol*, 5:165–8.
- Chaudry MM, Regenstein JM. 2000. Muslim dietary laws: food processing and marketing. In Francis J, ed. Wiley Encyclopedia of Food Science and Technology. New York: J Wiley. p 1682–4.
- Grunfeld I. 1972. The Jewish dietary laws. London: The Soncino Pr.
- Ratzersdorfer M, Regenstein JM, Letson LM. 1988. Appendix 5: poultry plant visits. In Regenstein JM, Regenstein DE, Letson LM, eds. A shopping guide for the kosher consumer. Albany, NY: Governor's Office (Governor Cuomo). p 16–24.
- Regenstein JM. 1994. Health aspects of kosher foods. Activities report and minutes of work groups & sub-work groups of R & D Associates. 46(1):77–83. San Antonio, TX: Research and Development Associates for Military Food and Packaging Systems.
- Regenstein JM. 2001. Cornell's multi-cultural kosher meal program. What does it mean to you? [online]. Accessed 26 Aug 2003. URL: [http://dining.cornell.edu/docs/multicultural\\_doc.pdf](http://dining.cornell.edu/docs/multicultural_doc.pdf)
- Regenstein JM, Regenstein CE. 1979. An introduction to the kosher (dietary) laws for food scientists and food processors. *Food Technol*, 33(1):89–99.
- Regenstein JM, Regenstein CE. 1988. The kosher dietary laws and their implementation in the food industry. *Food Technol*, 42(6):86, 88–94.
- Regenstein JM, Regenstein CE. 2000. Kosher foods and food processing. In Francis J, ed. Wiley Encyclopedia of Food Science and Technology. New York: J Wiley. p 1449–53.
- Regenstein JM, Regenstein CE. 2002a. The story behind kosher dairy products such as kosher cheese and whey cream. *Cheese Reporter*, 127(4):8, 16, 20.
- Regenstein JM, Regenstein CE. 2002b. What kosher cheese entails. *Cheese Marketing News*, 22(31):4, 10.
- Regenstein JM, Regenstein CE. 2002c. Kosher byproduct requirements. *Cheese Marketing News*, 22(32):4, 12.
- Sakr AH. 1996. Halal and haram defined. In: Understanding halal food: fallacies and facts. Lombard, IL: Foundation for Islamic Knowledge. p 26–7.
- United States Government Printing Office. 1996. The Code of Federal Regulations. 21CFR101.29. Washington DC: US Government Printing Office.

