Keeping enzymes kosher

Sacred and secular biotech production

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In 2010, as part of a research project, I accompanied the Orthodox Union's (OU) Senior European rabbinic field representative and Novozymes' Global Halal and Kosher Coordinator on the annual kosher inspection at Novozymes' production facility for enzymes in Denmark. You might find it surprising that a biotech company with an annual revenue of around US\$2 billion has its own Halal and Kosher Coordinator and conducts regular inspections to ensure compliance with religious dietary rules, but there are sound economic reasons why Novozymes—and many other companies—invests in obtaining such certifications. The global market for kosher and halal—a set of dietary rules for Jews and Muslims, respectively—has grown massively in recent years. The North American kosher food market grew by 15% between 2002 and 2012, with roughly US\$200 billion worth of kosher-certified food products sold annually. This increase is representative of a global trend [1]. In addition, many food companies and suppliers also cater to other dietary or philosophical requirements such as gluten-free, GM-free or vegan/vegetarian products, because doing so serves growing demand and markets.

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Kosher and/or halal certification (Fig 1) is a good example with which to study how sacred notions and beliefs influence the secular, commercial world of biotechnology.

The major driving factor is not increasing spiritualism alone, but also companies themselves that seek to expand into new markets and address the needs of new consumer groups. In doing so, companies and regulators are finding that the religious requirements might even enhance existing quality standards, giving companies a competitive edge. As we shall see, technoscience—both as material technology and specialized social expertise [2]—plays an important role in the interactions between sacred regulation and secular production.

Novozymes is an interesting case to study how this trend drives innovation and investments in the biotech industry. The company produces around 900 enzyme products for different industries that manufacture a variety of detergents, foods, beverages, textiles, biofuels, animal feeds and so on. In response to the bovine spongiform encephalopathy (BSE) crisis and increasing demand for kosher products, Novozymes began replacing animal ingredients in the production of its enzymes about 20 years ago. The company also started auditing for Jewish dietary law (*kashrut*) compliance in the late 1980s, and today about 60% of all enzyme products receive a designation of kosher. In 2000, the company created the position of Global Halal and Kosher Coordinator to oversee these efforts.

The commercial decision to have products designated as kosher or halal—a decision taken by many biotech and food companies—has created a secondary market of auditing and certifications firms. The Orthodox Union (OU), a Jewish organization that inspects Novozymes' production plants and certifies its products, is the oldest and largest kosher certifying body. It is a US community-based organization that certifies more than 500,000 products in more than 90

countries. OU started to standardize kosher in the 1920s when the Union of Orthodox Jewish Congregations established the organization to regulate slaughtering, meat processing and commercial food manufacturing. The complex web of contemporary food production means that individuals can no longer ascertain the *kashrut* of raw materials and products. Instead, large *kashrut* organizations such as the OU or the Organized *kashrut* Laboratories (OK) supervise the production process on behalf of consumers. Not surprisingly, there is competition between kosher certifying bodies.

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Generally, kosher is the application of a system of religious precepts and beliefs to regulate which types of foods people of the Jewish faith can eat. It is based on verses in the Old Testament, rabbinic Biblical exegesis, ordinances as presented in the Talmud, and the writings and decisions of rabbinic authorities. *Kashrut*, Jewish dietary law, and kosher law (*halacha*) include bans on pork and any pork products, the mixing of milk and meat and the listing of animal species that Jews are allowed to eat. Other important items that are regulated under kosher laws are rennin, gelatine, lactose, sodium caseinate (a protein produced from casein in skimmed milk) and vitamins [3]. Microorganisms or naturally occurring microflora

Figure 1. Kosher and halal certification logos.

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are considered kosher if they are grown on kosher media. The same applies to the use of enzymes in food production. Enzymes that derive from the stomach lining of animals are a potential problem as they cannot be mixed with dairy products because kosher requires that one does not “boil a kid in its mother’s milk”. Another challenge is that these animal enzymes often come from pigs or animals that are not ritually kosher slaughtered. In addition to food, kosher is also widely used to designate the “rabbinic properness” of a wide range of objects, products, activities, ideas and institutions [4]. To be able to sell a product as kosher, manufacturers or producers need certification by competent authorities, be that a rabbi or a company specialized in certification, such as OU or OK, which undertake the supervision and auditing of kosher production.

Kosher dietary practices provide a common symbolic system through which diverse groups of Jews can express and reinforce their Jewish identity. Many Jews are very careful about their kosher consumption, which has further reinforced the regulation of kosher production. The increased popularity of kosher from the 1990s onwards occurred because non-Jewish food producers began to market their products to the Jewish community even without understanding the religious significance of it.

Certification, regulation and inspections by kosher certifying bodies were a response to the growing number of non-Jewish producers and the increasing awareness among Jewish consumers. This trend has been particularly pronounced in the USA, where the market for kosher products is an example of successful private-sector regulation in an era of growing public concerns over the government’s ability to ensure food safety [5]. The rabbis who inspect producers and their notion of “rabbinic properness” play an essential role in implementing and ensuring kosher standards.

How does kosher compliance work in practice at a biotech company? Novozymes has had to change production processes and ingredients—such as replacing porcine gelatine with fish gelatine—which has been costly, but has also generated innovations that benefit the company today, as non-animal ingredients are regarded as a safe option in light of food scares and rising religious requirements.

Novozymes trains all staff involved in kosher production in the use of approved ingredients and raw materials and their handling, as well as the certification procedures. The coordinator is responsible for training and functions as the company’s overall authority, while at each of Novozymes’ seven production sites, one staff

member is appointed as a local coordinator. When kosher became an important requirement in the 1990s, the coordinator had assumed that information about kosher requirements would be available, but the only books he could find were written for Jewish housewives and not for production engineers. He obtained appropriate information from frequent meetings with OU representatives, including the rabbinic field supervisor, and developed Novozymes’ procedures and rules. Another source of information is the book *Kosher Food Production*, which many companies use as a handbook for production. This manual is an important tool for standardizing kosher principles, audits and inspections, and translating these into practice.

In principle, the coordinator could manage Novozymes’ kosher compliance without being an expert in kosher *per se*. However, there have been situations where the information available in handbooks has not been sufficient. He has thus developed his own significant expertise in kosher requirements. Furthermore, when training other people in kosher rules and compliance, it is helpful to have greater knowledge, which also enables the coordinator to better understand OU’s decisions and find applicable solutions in discussions with rabbis. Novozymes has also compiled a set of global procedures for kosher compliance. In addition, Novozymes’ production plants undergo regular inspections by the OU. Most inspections are announced, but unannounced inspections are becoming more frequent. Based on anecdotal evidence, the tendency is that other companies using more problematic ingredients or producing kosher and non-kosher products simultaneously experience more unannounced inspections.

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All Novozymes factories undergo a main kosher inspection at least once a year, as well as smaller follow-up visits. An inspection takes place over 2 days in several

facilities, including factories and warehouses. The coordinator informs employees to be prepared to receive the inspector at specific times in the different locations. These teams also receive inspectors from other local and international authorities, as well as customer audits. Hence, even if kosher inspections are only one type of inspection among others, employees generally consider kosher regulation different from other standards and regulations due to its divine origin.

An example of standardized practice is kosherization or ritual cleansing. In some cases, kosher inspectors perform kosherization of equipment in addition to the cleaning the company does itself, especially if equipment has become contaminated, for example after producing a product that contains milk-based ingredients. The ritual cleansing involves leaving the equipment inactive for 24 h prior to thorough cleansing with hot water or steam under the supervision of the OU inspector.

My visit in 2010 to Novozymes' Danish enzyme production facility allowed me to accompany a 2-day kosher inspection as part of my research to analyse how sacred beliefs and rules influence secular processes in biotechnology, such as large-scale industrial enzyme production. The OU inspector responsible for inspecting Novozymes is a senior European rabbi who grew up in the UK and holds degrees in chemical engineering. He is thorough, inquisitive, talkative and jovial. Staff told me that they enjoy the inspector's humour and that this makes kosher inspections something special. During my visit, the inspector himself was clad in the traditional black hat and dress of orthodox Jews, but as the inspection started, we all soon donned protective plastic suits.

“Kosher standards and standardization are thus means to create sacred things from the profane, but their implementation is also profoundly secular”

The inspector explained his work and the purpose of the inspection to me. By way of example, he related how, in the warehouse

of another company, he once found “piggy things”—which are clearly prohibited—being stored among products designated as kosher. Given that 99% of the raw materials used by Novozymes are already OU approved, his main focus was about potential cross-contamination and pollution and the auditing of accompanying documents and certificates. More specifically, much of the inspection focused on looking for proper kosher logos on products and raw materials and their trajectories. When we stopped at granulate mixing, the rabbi inspected containers with OU logos and asked questions about transportation: How do raw materials arrive? What are the delivery details? Who owns containers or are they rented? Who cleans these containers and how? Are there any papers on the tank truck? Interestingly, I found that an inspection to ensure the sacredness of biotechnology products focused mostly on profane technical questions about production processes, transport routes and documentation.

Another example from the kosher inspection of another company that chose to remain anonymous highlights how technology can be used to certify sacredness. This company's kosher coordinator explained that when OU and OK rabbis visit the factory, they use a substance such as Bitrex, the most bitter substance known, to test whether production processes follow kosher regulation. The inspector tastes water from a steam boiler that contains traces of non-kosher material to make sure that the water or condensate has been loaded with Bitrex to trace contamination. Such a test for potential contamination with non-kosher materials also highlights the use of technological tools to verify whether a substance is sacred, in addition to the more common application of historical and theological principles.

The standardization and documentation of proper handling and transport are challenging both for Novozymes and for companies that supply containers. Generally, traceability is of particular importance during kosher inspections, as raw materials have often travelled complex secular routes and therefore are of specific concern. The challenge is that enzymes that should be kept separate are often mixed in complex ways and that secular middlemen handle kosher ingredients in divergent ways

during trade and transport. In this “incestuous world of enzymes”, as the Novozymes inspector describes it, logos and labels are essential tools to verify the kosherness of products. Many of these issues are central not only to kosher, however, but also to general quality assurance. In fact, Novozymes undergoes a sizeable number of inspections each year and kosher inspectors are not considered radically different from inspections by state authorities, for example.

“... secular production and trade are impacted not only by sacred notions, such as kosher or halal, but also by other consumer beliefs...”

While inspecting the fermentation process, the inspector wanted to know whether any changes had taken place during the last 2 months that could have affected kosher status. In another area, the inspector enquired about the potential risk for contamination in a state-of-the-art steel tank, “because there were traditionally holes in metal containers and theological reasons, unfortunately”, he said. Another example of “theological reasons” was the inspector's concern with steam as a potential source of contamination if a common steam or hot water system is used in the processing of kosher and non-kosher products. Such concerns show the extent to which historical and theological principles condition production practices.

Generally, kosher regulation is a good example of how religious beliefs or notions of the sacred influence secular areas. It is also an example of how consumer demand impacts on industry by requiring standards for products and their production. Regarding the role of religious beliefs, French sociologist Émile Durkheim and Romanian philosopher Mircea Eliade in their works on the sociology of religion described how the sacred emerges in opposition to the profane as a dynamic and negotiable category [6,7]. According to Durkheim, the sacred is generated when it is lifted out of the context of ordinary, functional use. Yet, notions of sacred in turn can influence and change profane things like food production or biotechnology through

rules and regulations. Kosher and halal principles have played an important role in shaping knowledge, work processes and practices at Novozymes and have “sacralized” many production processes as well as enzymes.

Kosher standards and standardization are thus means to create sacred things from the profane, but their implementation is also profoundly secular. Kosher can refer to products and their production, preparation, handling and storage. Kosher can also be seen as an instrument of control, regulation and inspection, the purpose of which is to ensure the kosherness of products, and to reduce the risk of contamination. An important theme is the emergence of an audit culture. Audit and inspection systems are a feature of modern societies to provide comfort and reassurance to consumers. Staff policies, such as setting up the position of Global Halal and Kosher Coordinator, as well as establishing sections in companies that specialize in kosher compliance, are also examples of the increasingly prominent role of internal control systems to guarantee sacred products. Food scares and scandals have further increased the role of kosher and other inspections to control internal organizational arrangements and production systems.

Modern kosher production, trade, consumption and regulation share many similarities with halal, which is also gaining influence as companies cater to an increasing Muslim market. Moreover, the global market for vegetarian food products has massively expanded within the last few years. Nowhere is this more visible than in India, which is one of the largest and fastest growing markets for processed foods in the world. The country finds itself at the interface of three major transformations that are fundamentally reshaping conventional vegetarianism: Hinduization (promotion of Hinduism) of state and society, not least in the wake of the new Hindu nationalist prime minister Narendra Modi; an increasing number of companies and shops that cater to vegetarians; and the emergence of a new Hindu middle class of about 300 million consumers who are attentive to vegetarianism. In 2011, the Indian government mandated that vegetarian food must bear a

“green mark”, which shows that the global market for vegetarian products has entered a new phase characterized by bureaucratization, certification and standardization. Thus, kosher, halal and Hindu vegetarian markets and their regulation are examples of how the sacred is conditioning secular production, trade, consumption and regulation.

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These sacred markets are comparable to other trends within production, trade, consumption and regulation. In the EU, any food that contains a genetically modified organism (GMO), or that is based on a GMO, or an animal fed with GMOs must be labelled. There is no such legislation in the USA, but the US food retailer Whole Foods Market (WFM) recently announced that it would begin labelling all GM ingredients in products sold in its North American stores by 2018, reflecting a growing demand for GM-free food and a growing market in the USA. Furthermore, WFM’s collaboration with a non-profit, third-party certifier, the Non-GMO Project (NGMOP), again highlights the role of certification and food labelling. As such, secular production and trade are impacted not only by sacred notions, such as kosher or halal, but also by other consumer beliefs—in this case, that GM food could be harmful to human health or the environment.

From the point of view of biotech companies, kosher principles and practices are not radically different from other regulations and government-mandated standards, rules and regulations sacred or not sacred—with which they must comply to ensure the safety and quality of their products and production processes. Thus, companies and their procedures have

become more auditable, and in practical terms, this involves formalized procedures of inspections and negotiation with a certifier. This also means that technological and scientific modes and methods of quality assurance and traceability become increasingly important for producers, traders and certifiers to verify commodities as kosher, halal, GM free and so on.

Increased auditing and regulation is not necessarily a negative trend, as both companies and consumers benefit in various ways. While it is true that costly investments can be required to ensure compliance, potentially leading to increases in the cost of products, audits and inspections create and maintain consumer confidence and serve as additional quality control and assurance to keep consumers safe. In the long run, complying with sacred notions also allows companies to expand into new markets and target new consumer groups, as well as advertise the high quality of their products to secular consumers, as ensured by regular, sometimes religious, auditing.

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