Biotechnology patents in the food sectors

A closer look at the field, the players, and their strategies reveals a game of follow the leader.

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The food industry refers to firms that are involved in the processing and transformation of primary agricultural products into final consumable commodities. It forms the last link in the agrifoods chain (agribusiness and foods) that has been revolutionized by modern biotechnology. Although the integration of biotechnology directly in the food sectors has provoked heated debate in different parts of the world, little is known about the strategies of the organizations that are involved. This article aims to contribute to a better understanding of the issues involved by examining the following questions using patent data: Who are the leaders among the organizations patenting biotech-based technology applicable to the food sectors? What is the patenting gap between leaders and nonleaders? What kind of strategies are they pursuing in their patent applications?

The data for the analysis was compiled from the Derwent Biotechnology Abstracts (DBA) database. For each patent observation, the DBA gives the year of initial application, the year of publication, the names of the patentees (and affiliations after 1995), the region of protection sought at the time of application, the region of protection sought at the time of publication, and the associated technology fields. It must be noted that the DBA contains information on published patents, which may or may not have been granted depending on their country of origin. In the United States, a patent is published only if it is granted. Elsewhere, including Europe and Japan, the situation is different. A patent application is usually published within 18 months of application whether or not it is granted. The DBA covers 39 patent-issuing authorities, and for non-US issued patents it includes the first patent that comes to its attention. The DBA has very set selection guidelines for the inclusion of information. Patents are included in the food sectors only when recombinant DNA technology is involved. The DBA started in 1982, but the system of classification was changed around 1990. Thus, the present work is based only on patent publications that were added to the DBA after 1990 (i.e., applied for from 1988 onwards) and that were associated with the industrial sector "foods".

Two types of patentees were distinguished: the top 10 patentees and the rest. The top 10 patentees over the decade 1988–1997 were referred to as the "leaders", whereas the rest were termed the "nonleaders". Although this is an approximation in the sense that only the top 10 and not the top 11 or the top 20 were referred to as leaders (in this preliminary analysis), it yielded some interesting results.

Patentees distinguished as leaders or nonleaders are likely to influence new technology creation in the food sectors in different ways. R&D being subject to economies of scale, it is probable that patent leaders will be able to exploit their larger knowledge base better to increase their market share. Nevertheless, nonleaders are also an important group, because their depositions constitute the majority of patent applications.

Table 1. Leaders in food patent applications from 1988-1997

Rank 1988–1997	Name	Product focus	Patent applications
1	Mitsubishi (Japan)	Conglomerate	158
2	Ajinomoto (Japan)	Life sciences	133
3	Nippon (Japan)	Conglomerate	103
4	Kyowa (Japan)	Pharmaceuticals	87
5	Novo Nordisk (Denmark)	Pharmaceuticals	73
6	Asahi (Japan)	Foods	56
7	Mitsui (Japan)	Conglomerate	45
8	Hayashibara (Japan)	Life sciences	45
9	Nestlé (Switzerland)	Foods	36
10	Gist-Brocades (DSM) (Netherlands)	Life sciences	33
Total			769

Who are the leaders?

In our database, containing food patents applied for between 1988 and 1997, there were 3,731 patent observations by 1,170 patentees. Table 1 identifies the leaders. These 10 organizations, making up 0.9% of the total number of patentees, are all firms—that is, no laboratories figure among them. Nonleaders include laboratories and individuals in addition to firms. The product focus of a majority of leaders are not only limited to foods. For instance, Novo Nordisk and Gist-Brocades are not food companies, and the main thrust of their knowledge strategies is not directly geared toward foods, although they produce many enzymes very useful to the bread and beer industries. Strikingly, 7 of the 10 leaders

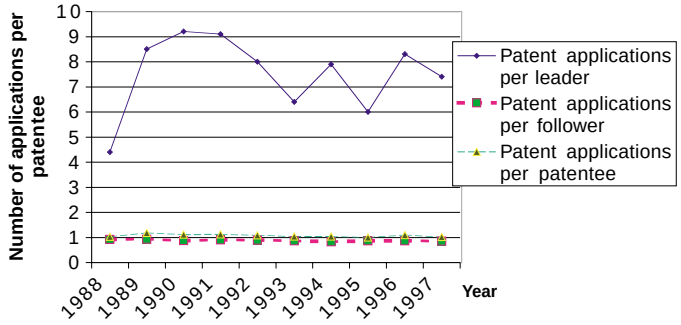

Figure 1. Patent performance of leaders and nonleaders, showing a substantial performance gap.

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are Japanese. This can partly be explained by the distinction of the Japanese style of patenting. Whereas American or European companies tend to take out "umbrella patents" covering the different technological stages of the production process, Japanese companies tend to patent every stage of the production process separately, increasing the number of patents associated with the process.

In order to have an idea of the gap between leaders and nonleaders, the number of patent applications per patentee was computed for the group of leaders and nonleaders. The number of nonleaders were identified for each year between 1988 and 1997. Then the number of patent applications by nonleaders was divided by the number of nonleaders, and the number of patent applications by leaders was divided by the number of patent leaders (i.e., 10) to get the number of patents per patentee of a nonleader and a leader. These were then compared with the average profile or total number of patent applications divided by the total number of patentees. The profiles are given in Figure 1. As the figure shows, the performance gap between a leader and a nonleader is substantial. The gap seems to be a function of the patent performance of the leaders, because the patent performance of nonleaders seems to be stable. This brings us to the question: is the performance gap between a leader and a nonleader due to greater access to resources or to better patent strategies? We will try to answer this question by comparing the patent strategies of leaders and nonleaders.

Although the performance gap between leaders and nonleaders is large, there is hardly any difference in their strategies.

Structure of technology affiliations

Every patent observation of the DBA is classified as being affiliated with one or more of 12 technological fields. Of the 3,731 patents deposited in the food sectors, only 29 were not affiliated with any other technology field. The internal structures of the technology affiliations of the food patents of leaders and nonleaders are given in Table 2. Shown is the distribution of the technology affiliations of food patent applications over the different technology categories.

Table 2 reveals that patents of leaders and nonleaders have very similar internal structures, with approximately a third of their food patent applications affiliated to biocatalysis, a third to genetic engineering, and a third to other fields. However, the nonleaders and leaders are distinct in terms of their fields of focus in two categories. Nonleaders produce a significantly greater percentage of food patents affiliated to agriculture and environment.

Table 3. Organization and protection strategies

	Internal structure of patent applications 1988–1997 (%)	
	Leader	**Nonleader**
Organization of patent applications		
Individual	92.84	90.04
Collective	7.16	9.96
Total	100	100
Region of final protection		
National	60.94	66.96
Regional	20.7	12.55
International	18.36	20.49
Total	100	100
Typology of collective applications		
Firm–firm	90.91	54.59
Firm–lab	9.09	45.41
Total	100	100

Organization and protection strategies

Table 3 details the organizational and protection strategies behind patent applications. There is a widely promoted proposition that R&D and technology collaborations are on the rise in knowledge-based sectors. The arguments are that firms collaborate more to share increasing costs and to spread risk. Interestingly, our findings indicate just the opposite, with both leaders and nonleaders preferring to take out individual patents.

In terms of protection strategies, leaders and nonleaders are similar in that around 20% of the patents taken out by both groups enjoy international protection. The difference is in national and regional protection. Nonleaders appear to be more local players than leaders.

The collaboration strategies show that leaders prefer to collaborate with firms rather than with laboratories. More than 90% of their collaborations are with other firms. Nonleaders on the other hand collaborate equally with firms and laboratories. The firm–firm collaborations of leaders are nearly always with nonleaders. Only one collective patent was deposited by two leaders during the years considered.

Conclusions

Although the performance gap between leaders and nonleaders (in terms of the number of patent applications per patentee) is large (and varying with the performance of the leaders), there is hardly any difference in their strategies. Both groups are focused on biocatalysis (which covers enzyme engineering) and genetic engineering; they prefer individual patent applications to collective ones, and both prefer national protection. Given that their patent strategies are similar, this would lead us to infer that the better performance of the leaders, which are all large companies, is due to greater resources or the realization of firm-specific objectives.

Table 2. The internal structure of the technology affiliation of food patent applications by leaders and nonleaders

	Internal structure 1988–1997 (%)	
	Leaders	**Nonleaders**
Biocatalysis	36.23	28.45
Genetic engineering and fermentation	36.15	38.11
Chemicals	9.18	5.33
Pharmaceuticals	7.69	9.28
Purification	3.97	3.59
Environment	2.15	5.33
Cell culture	1.74	2.62
Energy	1.16	1.32
Biochemical engineering	0.99	2.08
Agriculture	0.74	3.53
Analysis	0	0.36
Total	100	100