THE INNOVATION STRATEGY OF A NON-FOOD-INDUSTRY COMPANY REGARDING THE TRADITIONAL FOOD SUPPLY CHAIN

Daisuke Kanama, Taketoshi Kido

Tokyo University of Agriculture, 1-1-1, Sakuragaoka, Setagaya, Tokyo, 156-8502, Japan

Abstract

This article focuses on the innovation strategies employed by a chemical manufacturer as a new non-food-industry player in a traditional Japanese food – tofu (soybean curd) – manufacturing industry. Many consumers assumed that the taste of tofu was attributed to the type of soybeans and manufacturers' technical know-how. However, tofu products with different tastes could be manufactured by varying the type of coagulant. In the 1990s, a major Japanese chemical manufacturer developed a new coagulant which controlled first the rapidity of coagulation. This article then discusses how the company has become the main controller of the tofu industry supply chain.

Key words: *innovation strategy, non-food company, traditional food industry, tofu, coagulant*

1. INTRODUCTION

Much of the previous literature argues that innovation activities are not as brisk in the food manufacturing industry as in other industries (Christensen, Rama, and von Tunzelmann, 1996). In particular, the food manufacturing industry's low level of R&D intensity compared with other industries has been highlighted (Martinez and Briz, 2000). In this context, the EU analyzed the competitiveness of the food manufacturing industry in the EU area and stressed the need to strengthen the industry's innovation capability (CIAA, 2008). Consequently, capturing returns from innovation has become a challenge (Costa and Jongen, 2006).

Given the ongoing shift in food demand, customization must be focused upon as a platform for innovation in food companies (Boland, 2008). Today's consumers have come to prefer products tailored to their tastes. This preference is partly due to the aging of society across developed countries as a whole. A Japanese survey shows that the older a family becomes, the larger the proportional share of food expenditures in the family budget. Although caloric intake decreases with age, food expenditures do not. In other words, expenditure per calorie rises over today's human lifespan.

The median age in developed countries, which was 34.4 in 1990, is projected to reach 41.8 in 2020. In addition, the proportion of people aged 65 or older in the global population is projected to grow from 12.5% in 1990 to 19.1% in 2020. In the near future, the elderly will form the core consumer base in developed countries, and elderly consumers have a critical eye regarding food because they are very sensitive to food's health benefits. As a result, food companies are now required to have the following four capabilities. First, companies must enjoy a high level of science and technology. In recent years, it has become difficult for companies to undertake technologically advanced innovation activities with internal resources alone. Useful knowledge and technology may be found in external organizations, including suppliers, users, universities, competitors, and companies from different industries (Laursen and Salter, 2006; Laursen, 2012). The advance of such open innovation obviates the need to wholly internalize the scientific and technological resources necessary to develop new products. All the same, even if external knowledge and technology are used, the capabilities to evaluate and incorporate such knowledge and technologies are necessary (Cohen and Levinthal, 1989; 1990).

Second, companies must have the capability to use more sophisticated marketing techniques to acquire a better understanding of the differentiated needs of consumers (De Jong, van Kleef, Frewer, and Renn, 2006). In particular, localized needs should be identified through the mass-marketing techniques that have traditionally been employed by food companies, to develop products into brands.

Third, companies must have the organizational capability necessary to conduct such activities. As many food companies are pursuing international business expansion, companies need the organizational

capability and manpower to conduct marketing research that extends across multiple countries.

Fourth, companies must develop business models that eventually turn the activities discussed above into profits. Developing products that bring new experiences to consumers is risky and uncertain. Business models must be developed that bring profits to companies by making it more difficult for competitors to imitate products while controlling risk and uncertainty (Bogers, 2011; Lichtenthaler, 2011).

With respect to some or all of these activities, collaboration with external actors is necessary; however, when engaging in such collaboration, consideration must also be given to the risk of information and technology leakage. In other words, companies face the paradox of openness, which forces them to weigh the benefits of diversity brought by openness against the risks of appropriability (Lausen and Salter, 2014; Dahlander and Gann, 2010). Collaborating with external actors and opening internal technologies to the outside generates the risk of a leak of classified knowledge (Breschi and Lissoni, 2001; Cassiman and Veugelers, 2002). To guard against such an unexpected leak, companies take various countermeasures through a variety of legal procedures, including obtaining patents and design rights (Grimpe and Hussinger, 2014). The business model that can be effectively employed under these circumstances attempts to control the entire supply chain amid the growing numbers of stakeholders and related actors (Omta and Folstar, 2005).

Moreover, existing food companies must also guard against assaults from companies from outside the various food industries. In recent years, there have been cases in which a more innovative company from a non-food industry entered a food industry supply chain and achieved success through innovation. These external companies have enhanced their innovation management while continuing to engage competitively in their original markets as they attempt to steal market share and compete in the food industry.

In this paper, we will focus on the tofu (soybean curd) industry – a traditional Japanese food manufacturing industry – as a case typifying this phenomenon. We will analyze a company from the chemical industry that has entered the food industry as a new player and has become the main controller of the food industry's supply chain for a particular good. How did this company enter the food industry, which was an entirely new market to the company? In addition, how did it achieve success as a "game-changer"? How did the company develop a simultaneously open and closed business model? In this paper, we will examine the strategy that allowed the company to achieve this "game change" based on a careful analysis of the characteristics of the tofu industry as a traditional food industry and based on some specifics in its technical background.

2. APPROACH

In our research, we will use the case study method in which a single case is studied. A case study is effective to deepen the understanding of a complicated incident and of phenomena that deviate from statistically predicted behavior as well as to develop new theory and theoretical insights (Yin, 2009; Flick, 2014). However, a single case study also has certain limitations, e.g., reliability and breadth of perspective. Nonetheless, in this research, a single case study has two advantages. The first is that we can dynamically examine the relationship between multiple actors (Latour, 2005). When creation and destruction occur in a traditional industry as in this case study, multiple actors reveal complex behavior in their respective contexts. A single case study enables us to resolve such complexity based on the scenario approach by focusing on a specific actor. The other advantage is that it is easy to expand or apply an existing theory to a different field. The theory of open innovation, which forms the theoretical basis of this study, has been applied mainly to the high-tech industry. This research attempts to extend the theoretical framework of open innovation to a traditional segment of the food industry.

As will be explained in detail below, tofu is a traditional food that has been consumed by the Japanese throughout a long period of history. However, the ongoing diversification of culinary life has had an impact on this industry. In Japan, tofu is sold mainly in blocks (each block weighs approximately 350 grams). In recent years, the retail price of tofu has declined, and the number of tofu makers in Japan has decreased accordingly. In the past, each small community in Japan had its own tofu maker, but Japanese

tofu makers are disappearing at the rate of approximately 500 annually (Figure 1). What is causing this decline? This study aims to address the research question and uses data triangulation and information by means of multiple interviews and documents, such as papers, patents, and project reports. Based on this analysis, we will show that the wave of open innovation has arrived in this old hidebound industry, allowing one supplier to assume control of its value chain through a sophisticated strategy combining open and closed approaches.

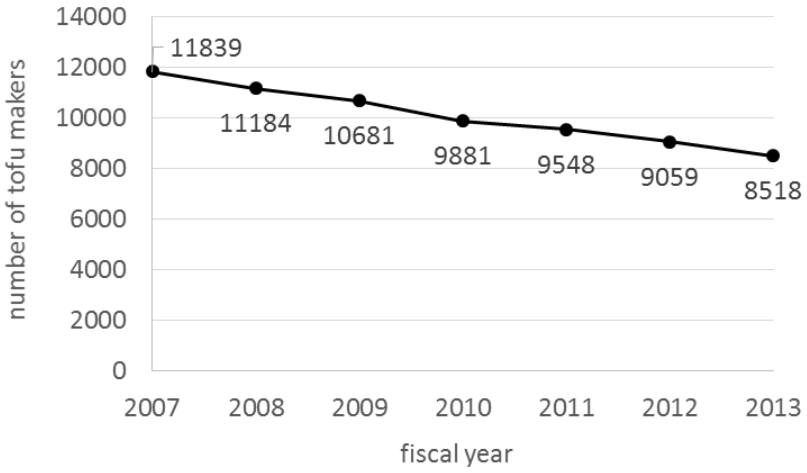


Figure 1. Number of tofu makers in Japan

3. CHARACTERISTICS OF TOFU PRODUCTS

3.1. Historical Background of Tofu and Its Position in Japanese Food

Tofu is a soybean-based food that was developed in China, and its history is said to date back more than 1,000 years. Subsequently, the tofu culture, including manufacturing and cooking methods, spread to various Asian countries. In Japan, tofu was once a food available exclusively to people in high positions, such as aristocrats and priests, but in the Edo Period (beginning in 1603), tofu consumption gradually spread among the general public as the social environment changed.

In the modern era, low-cost tofu manufacture on a large scale became possible as a result of the development of manufacturing machinery. Subsequently, various technological developments and innovations have continued to impact the industry, creating a unique tofu culture in Japan. In spite of the ongoing diversification of culinary life, Japanese retail stores continue to set aside a large dedicated space for tofu, showcasing a variety of tofu products supplied by myriad tofu makers, including *momen* tofu (firm tofu), *kinugoshi* tofu (soft tofu), *yose* tofu (fresh tofu), and *yaki* tofu (grilled tofu). Like sushi, tofu has become a symbol of Japanese culinary culture; its uniqueness is drawn out with simple preparation, permitting its sensitive enjoyment with only a tiny amount of salt-based seasonings – such as soy sauce for flavor enhancement.

In Japan, tofu has become associated with localization for the following four reasons.

1) Manufacturing methods have been developed to suit various regional climates.
2) Tofu products that are transported do not typically compete well against local products because transportation costs are high relative to tofu's low retail price.
3) Transportation time is a bottleneck for long-distance delivery because tofu's shelf life is relatively short.
4) Tofu has been integrated into traditional local food because its mild, unobtrusive taste makes it highly useful as a food material.

3.2. Differentiation of Tofu Products and Three Competitive Factors

The raw material of tofu is soybean. Approximately 90% of soybeans used in tofu manufacturing in Japan are imported from the United States and Brazil. As imported soybeans are cheap and stable in quality, they are important materials for tofu makers. Nonetheless, some tofu makers appeal to consumers by offering tofu products made exclusively from soybeans grown in Japan. As Japanese soybeans are unstable in terms of quality and harvest amount, they are relatively expensive. However, some consumers prefer Japanese soybeans, and using them may become a differentiating product factor. As tofu manufacturing in Japan dates back to the Edo Period, manufacturing methods vary greatly from region to region and from maker to maker. This variation results in subtle differences in the taste and texture of different types of tofu that are created by tofu artisans; artisanal skill and technical know-how may be a differentiating factor.

Accordingly, many consumers assume that the taste of tofu is attributable to the variety of soybean used as the raw material and to manufacturing and technical know-how. Although this assumption is not incorrect, it is only part of the story. In reality, even if the same variety of soybean and the same manufacturing technical know-how are used, tofu products with different tastes can be manufactured by varying the type of coagulant.

Tofu makers have found it difficult to develop new products with distinctive characteristics by means of selective soybean breeding, which takes a significant amount of time. Therefore, tofu makers have turned to developing additives such as coagulants, which has brought significant change to the tofu industry.

In this study, we will examine the development of tofu products in recent years, with a particular focus on coagulants as the third determining element in the taste of tofu, along with the variety of soybeans and the manufacturing know-how. As part of our examination, we will analyze the innovation process and competition for leadership in tofu manufacturing.

4. DETERMINANTS OF TOFU COAGULANTS

In the past, liquid residue called "nigari*"* (bittern), a byproduct of salt production from seawater that consists primarily of magnesium chloride, was used as the coagulant for tofu. Today, refined and crystallized magnesium chloride is also used as a coagulant. Although nigari had long been used as a tofu coagulant, tofu makers became unable to use it during wartime because the military industry needed magnesium as an alloy material. As a result, calcium sulfate was used as an alternative agent to provide soybean protein with bivalent cations, which are necessary in the coagulation reaction.

As calcium sulfate is less soluble than magnesium chloride, it takes a long time for calcium and soy protein to bond with one another and to coagulate. As a result, more water is retained during the coagulation of the protein, making it possible to manufacture tofu with increased water content and a soft texture. Compared with nigari, which was difficult to handle industrially because of its high coagulation rate, calcium sulfate makes it easier to control the manufacturing process because it coagulates more slowly. As a result, the use of calcium sulfate spread widely among tofu makers. However, calcium sulfate is inferior to nigari in terms of taste because of the acridity attributable to its sulfate content and because of an unfavorable feel on the tongue created by its calcium content. However, based on its ease of handling during the industrial process, calcium sulfate continued to be used as a tofu coagulant even after nigari became available in abundance in the postwar period.

Shortly after calcium sulfate began to be used by tofu manufacturers, glucono delta lactone (GDL) also came into use as a tofu coagulant. When added to soy milk, GDL gradually undergoes hydrolysis and becomes gluconic acid. During this process, the pH level declines, resulting in acid coagulation of protein. As it takes time for GDL to become gluconic acid after it is added to soy milk, GDL has the slowest speed of coagulation among those coagulants generally used (Table 1). As a result, GDL makes it possible to develop a gel structure with high water retention that, in turn, leads to tofu with a smooth feel to the tongue. Meanwhile, tofu products using GDL are clearly different in taste and texture from those using nigari or calcium sulfate. Therefore, to improve the taste and texture of GDL-based tofu

products, compound agents consisting mainly of GDL but also of nigari or calcium sulfate have been developed and are in widespread use.

Generally speaking, the higher the temperature used in the process to make tofu, the faster the chemical reaction. In the process of tofu manufacturing, water-soaked soybeans are mashed and heated to a temperature near boiling. By adding the coagulant to soy milk separated from the pulp (okara) immediately after the boiling process, the ingredients are processed into tofu. When nigari is used as the coagulent, with its high rate of coagulation, the protein that comes into contact with the coagulant begins to coagulate because the temperature of the soy milk is very high, making it difficult to manufacture tofu with a uniform structure.

However, because of their slow speeds of coagulation, calcium sulfate and GDL make it possible to uniformly mix soy milk and the coagulant before the process of coagulation is initiated, enabling the manufacturing of tofu with a uniform structure and high water retention. As a result, under ordinary tofu manufacturing, while tofu using nigari is favorably evaluated in terms of taste, it is believed that nigari is not suited for the manufacture of *kinugoshi* tofu (soft tofu), for which it is important to ensure a smooth texture. When manufacturing *kinugoshi* tofu using nigari, the soy milk must be temporarily cooled when adding the coagulant to prevent coagulation from initiating and the nigari and the milk must then be mixed uniformly before re-applying heat to begin coagulation. This manufacturing method cannot be undertaken by all tofu makers given the cost of the equipment and energy necessary for the cooling and re-heating processes.

Type of tofu coagulant	Time of coagulation after adding the coagulant to hot soy milk (Sec)
Magnesium chloride	2
Calcium sulfate	30
Glucono delta lactone (GDL)	60

Table 1. Type of tofu coagulant and coagulation time

5. THE ARRIVAL OF THE FOURTH COAGULATION AGENT OPTION

As a result of the changes and technical developments that were described in the previous section, tofu culture gradually became more diverse. The diversification of coagulants played a significant role in this shift. Compared with the pre-war period, when *momen* tofu (firm tofu) using nigari was the mainstay, in the post-war period, the time was ripe for *kinugoshi* tofu, which was suited to consumers' preferences at low cost now that *it* could be made with a smoother texture.

Amid consumers' demand for such tofu, the technology to realize slow coagulation of tofu using hot soy milk and nigari was developed in the 1990s. In 1992, the Kao Corporation developed an emulsified nigari – which controls the rapid coagulation that occurs when nigari is added to soy milk – and filed a patent application. The emulsified nigari is made by using an emulsifying agent to disperse nigari throughout oil and fat.

If the emulsified nigari is added to hot soy milk, the coagulation reaction does not proceed because it is coated with oil and fat. When the emulsified nigari is processed through an emulsifying apparatus and the homo mixer machine – which destroys the emulsified state – the soy protein contained in the soy milk comes into contact with the nigari, triggering coagulation. Slowing down the reaction speed makes it possible to manufacture *kinugoshi* tofu with a favorable texture while using nigari, while the moderate speed of coagulation enables the manufacture of tofu with high water retention. In addition, the oil, fat, and emulsifying agent contained in the emulsified nigari improve the texture of tofu by making it smoother, and the oil and fat make it possible to manufacture tofu with a rich and a full-bodied flavor.

Several types of emulsified nigari sold by Kao under the Magnesfine brand are currently used by tofu makers. Since filing for its first patent application in 1992, Kao has continued to develop similar nigari, filing at least eight patent applications to date. Other companies such as Riken Vitamin Co., Ltd. and Fuso Chemical Co., Ltd. Followed Kao in developing slow-acting coagulants, which are created by using an emulsifying agent to disperse a water-soluble coagulant throughout oil and fat.

To use emulsified nigari, there is an initial capital cost to tofu makers of introducing an emulsifying machine. However, compared with existing methods of temporarily cooling the hot soy milk and applying heat again after adding nigari, the use of emulsified nigari is cost-saving in most cases and is thus advantageous overall. As discussed above, there is no doubt that emulsified nigari, which is created by means of a chemical process is different in nature from traditional nigari and has arrived as a revolutionary innovation in the history of the development of tofu manufacture.

6. DISCUSSION: BRINGING INNOVATION TO THE TOFU MANUFACTURING PROCESS FROM A DIFFERENT INDUSTRY

Figure 2 shows the tofu manufacturing process. Soybeans, as the primary basic raw material, are soaked in and made to absorb water and then mashed in a grinding machine. The liquid residues are separated into pulp (okara) and soy milk through filtration after being heated. As discussed above, some tofu makers add a coagulant to the hot soy milk at this point, while others do so after temporarily cooling the milk. Subsequently, the ingredients will be formed into tofu while being immersed in water. Although the manufacturing method may differ, tofu is always solidified soy protein curd.

Each process requires sensitive technological know-how. As a result, the taste of different tofu products may vary subtly even when they are manufactured using the same process, depending on who (which tofu artisan) manufactures them. The timing of each process, temperature management, the understanding of the characteristics of the raw materials, and the speed and intensity of mixing are all part of artisans' know-how. However, the use of emulsified nigari and the separation apparatus makes it possible for anyone to implement the process efficiently and to reproduce the same taste. This significant change to the industry has been driven by Kao, a newcomer from the chemical industry. Kao's main products are detergents, cosmetics, and sanitary goods; prior to entering the tofu industry, the company had little experience in the food sector (except for beverages).

The creation and destruction undertaken by Kao are as follows. Kao developed a business model that combined open and closed approaches. First, Kao internally proceeded with the development of emulsified nigari. After refining the development as a product innovation, the company secured the rights to the product as a substance patent. Simultaneously, Kao created a situation in which a special mixing machine was necessary to manufacturing tofu using emulsified nigari. In other words, Kao developed emulsified nigari and introduced the mixing machine as a set. Thus, Kao accumulated the technology related to the mixing machine as its internal know-how rather than applying for a patent.

If the company had commercialized its technology at this stage, it would have begun selling emulsified nigari and the mixing machine as a set to tofu makers. Under this business model Kao would sell emulsified nigari periodically to users after introducing the mixing machine to them.

However, instead of launching that type of business model at that time, Kao opted to promote its own rapid expansion into the tofu market and to control the market (Figure 3). The company shared the manufacturing method of the mixing machine and relevant know-how to some machine makers. This arrangement was expected to improve the tofu manufacturing and lower its price. At the same time, as Kao secured the rights to emulsified nigari, tofu makers had to purchase it from Kao regardless of which machine maker they might purchase the mixing machine from. This division of work enabled Kao to exercise control over both the rapid expansion of the emulsified nigari market and the continued improvement of the tofu manufacturing quality.

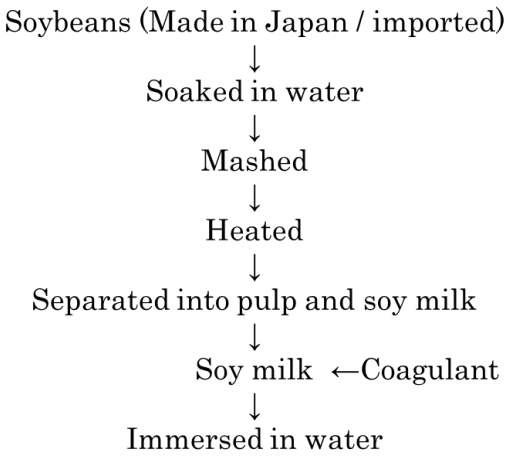


Figure 2. Process of soft tofu manufacturing

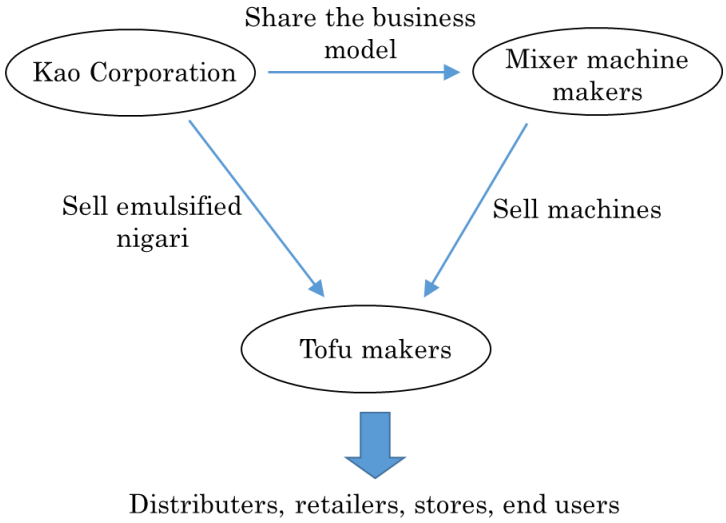


Figure 3. Strategy of Kao Corporation to promote its rapid expansion into the tofu market

7. CONCLUSION

This paper focused on the tofu industry, which is a traditional Japanese food manufacturing industry, and analyzed the entrance into the supply chain of a manufacturer from the chemical industry. The chemical manufacturer entered the food industry as a new player and has since become the primary controller of the supply chain.

Previously, many consumers assumed that the taste of tofu was attributed to the type of soybeans used as raw material and manufacturers' technical know-how. However, in addition to the variety of soybeans and manufacturing skills, tofu products with different tastes could be manufactured by varying the type of coagulant. In the 1990s, a new technology was developed that enabled tofu to coagulate slowly with hot soy milk and new nigari. Kao Corporation, a major Japanese chemical manufacturer, developed an emulsified nigari, which controlled the rapidity of coagulation when nigari is added to hot soy milk. The emulsified nigari is made using an emulsifying agent to disperse nigari throughout oil and fat.

This newcomer has changed the value chain of the tofu industry. Using the emulsified nigari and a mixer machine has made it easier and cheaper to manufacture tasty tofu without the need for skilled professionals. Additionally, Kao Corporation succeeded in rapidly expanding into the market for

emulsified nigari by introducing the technology to various machine makers that in turn supplied the machines to tofu makers. In this manner, this study found that a new entrant from outside the food industry gained control of the market.

The following limitations remain in this article. First, this study used a single case method. As discussed above, although a case study is effective in deepening the understanding of a complicated incident and various phenomena, a single case study has some limitations such as the lack of reliability and breadth of perspective. To overcome these limitations, more cases should be studied in addition to that of the tofu manufacturing industry, and statistical analyses should also be undertaken.

Moreover, the further evolution of the tofu industry should be watched carefully. Driven by the emergence of a newcomer, many firms outside the food industry have entered into this market, which had remained static for a long time. These firms have attempted to replace the emulsified nigari with alternative product innovations, thereby leading to further diversification of tofu product lineups. For example, flavored tofu is on the market. These innovators thus have the potential to re-energize the shrinking tofu market.

REFERENCES

Bigliardi, B. & Galati, F. (2013). Innovation trends in the food industry: The case of functional foods. Trends in Food Science & Technology, 31, 118-129.

Cassiman, B & Veugelers, R. (2002). R&D cooperation and spillovers: Some empirical evidence from Belgium, American Economic Review, 92(4), 1169-1184.

Bogers, M. (2011). The open innovation paradox: knowledge sharing and protection in R&D collaborations. European Journal of Innovation Management, 14 (1), 93–117.

Boland, M. J. (2008). Innovation in the foods industry: personalisation and mass customization. Marcure, J., Moughan, P. and Bruhn, C. (Eds.), Innovation, management policy and practice, Vol. 10e-Content Management Pty, 1–132.

Breschi, S. & Lissoni, F. (2001). Knowledge spillovers and local innovation systems: A critical survey. Industrial and Corporate Change, 10(4), 975-1005.

Christensen, J. L., Rama, R. & Von Tunzelmann, N. (1996). Study on innovation in the European food products and beverages industry. European Innovation Monitoring System, EIMS publication, 35 European Commission, Directorate General XIII, Luxembourg.

CIAA, (2008). Review of key competitiveness indicators for the European food industry. CIAA, Brussels.

Cohen, W. M. & Levinthal D. A. (1989). Innovation and learning: The two faces of R&D. Economic Journal, 99(397), 569-596.

Cohen, W. M. & Levinthal D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly, 35(1), 128-152.

Costa, A.I.A. & Jongen, W.M.F. (2006). New insights into consumer led food product development. Trends in Food Science and Technology, 17, 457–465.

Dahlandera, L. & Gann, D. M. (2010). How open is innovation? Research Policy, 39(6), 699-709.

De Jong, J., van Kleef, E., Frewer, L. J. & Renn, O. (2006). Perceptions of risk, benefit and trust associated with consumer food choice. Frewer, L. J., van Trijp, H.C.M. (Eds.), Understanding consumers of food products, Woodhead Publishing, Cambridge, England, 125–150.

Flick, U. (2014). An Introduction to Qualitative Research. CA: Sage.

Grimpe, C. & Hussinger, K (2014). Resource complementarity and value capture in firm acquisitions: The role of intellectual property rights. Strategic Management Journal, 35(12), 1762-1780.

Latour, B. (2005). Reassembling the Social: An Introduction to Actor-Network-Theory. Oxford: OUP.

Laursen, K. (2012). Keep searching and you'll find: What do we know about variety creation through firms' search activities for innovation? Industrial and Corporate Change, 21(5), 1181-1220.

Laursen, K. & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. Strategic Management Journal, 27(2), 131–150.

Laursen, K. & Salter, A. (2014). The paradox of openness: Appropriability, external search and collaboration. Research Policy, 43(5), 867-878.

Lichtenthaler, U. (2011). Is open innovation a field of study or a communication barrier to theory development? A contribution to the current debate. Technovation, 31, 138–139.

Martinez, M. G. & Briz, J. (2000) Innovation in the spanish food & drink industry. International Food and Agribusiness Management Review, 3 (2), 155–176

Omta, S.W.F. & Folstar, P. 2005 Integration of innovation in the corporate strategy of agri-food companies. Jongen, W.M.H. and Meulenberg, M.T.G. (Eds.), Innovation in agri-food systems, Wageningen Academic Publishers, Wageningen, pp. 223–246.

Yin, R. K. (2009). Case study research. Design and methods. Thousand Oaks. CA: Sage.