

The role of technological innovation in the development of new products: a study in the food industries

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Abstract: The aim of this work is to describe companies of the food sector in relation to the effort for technological innovations towards the development of new products. A qualitative survey using studies concerning this matter was conducted in three companies of this segment. They were located in two important centres with a large production and consumption rate. The analysis of the results showed that there is more technological innovation in process than in product. The aim of developing new products was mainly to improve those already existing. The result of this was some alterations in taste and better packaging. Using technology led to organizational changes and suitability of the plant's layout. The companies share a little in the cooperative arrangements, however when they do this they look for some universities near the plants. The greatest difficulties for technological innovations were costs, economic risks and the possibility of rejecting products.

Keywords: development of new products, technological innovation, food industry

1. Introduction

The development of new products is regarded as an essential tool to the competitiveness of the companies, due to the market crescent internationalization and the need to attend the expectations of more and more exigent consumers.

It is expected that the benefits resulted from the developmet of new products and the improvement in quality of others already made mean a greater profit and market gain for the companies. In order to reach these benefits the company must control the use of certain technologies, applying them to their products during the development of the process.

The transference of technology to the products is realized in the differents steps of their process of development. However, it is observed that in national companies, that transference happens in a very reduced way, and it leads to the improvement of the already made products, fitting them to the local market needs, to the suppliers structure and to the avaiable production process (AMARAL, 2005).

This situation is especially frequent in the food products segment, a sector characterized by incremental innovations.

In accordance with CONCEIÇÃO & ALMEIDA (2005), the need of innovations in food products is nowadays a consequence of a greater competition in the markets characterized for a smaller constraint to the free commerce and reduction of the cycle of life of the products, and it requires changes in features and quality products.

In order that the innovation succeeds, the food industry must regard two main features: the greater strenght of the market over new products and the costumer's needs, that change with local habits, culture and customs. Subjectivity is very accentuated in this segment since the taste is a personal matter and the possibility of rejection or fitness in taste is very great (NANTES, 2001).

Beyond attending the costumer market requirements, the innovation in the products and process in this segment must also accomplish the requirements of healthfulness, both in the production process and the final ready for consumption product. The care with health increases more and more in relation to food safety and its nutritional features.

For this reason, the strategies towards differentiation of products by their quality have taken a new dimension in the food industry, being the technology the needed tool for attending the consumer requirements.

In despite of these reasons, the Brazilian industry innovates very little. According to IBGE, data in the 2000, 77.1% of Brazilian industries did not improved their products. Although these companies correspond to the majority of the national industries, they represent just 11.5% of the income and 38.2% of the labour force. Therefore, there is space for the companies to advance in the differentiation of their products based in some innovations.

It is in this contex that this work is inserted, its main objective is to characterize the food companies in relation to the strength to the innovation on technology in the new

product development. More accurately, this work aims to identify how the companies have used the technological innovations, the practical benefits and the main difficulties to develop new products and process.

Beyond these objectives, they try to identify the external collaboration to the company looking for innovation, including the qualification means used by the companies, since these procedures turns easier the adoption of the technological innovation, making it possible its incorporation in the products of the companies.

In order to attend the proposed objective it was chosen a qualitative approach, developed through studies of a case, in three food companies in the São Paulo state, that participate in the sweet and biscuit segment. The companies have own national capital and participate in the internal and external markets.

The survey in the field was realized by personal interviews, using a route for the interviews semi-structured directed to the companies executives, allowing interation between researchers and companie’s representatives, such as the answers were discussed and originate new questions enlarging the initial route.

The route of interviews was made basing in the characterization of the companies in relation to the effort to technological innovation of products and process, in accordance with the seven categories of activities indicated by the Tecnological Innovation Survey realized by IBGE in 2003.

2. Technological innovation

Due to the continuous globalization process, the companies had to face a dynamic market, unstable and evolutive, with the cycle of life of the products more and more short, intensifying the adoption of technological innovations for the new products development and improving the actual ones.

2.1. Basic concepts

The innovation may be seen by two different ways: the adoption and the effort for innovation. In the first case, the company invests on equipment for new process, while in the second it occurs a commercialization of new products and/or implementation of new equipments developed by its proper process. To these ways of innovation, SANTINI & SOUZA FILHO (2005) added that the companies may also inovate by jointing adoption with effort for innovation when, for instance, new technologies of process are fitted to their particular needs.

The technological innovation may result in products and process technically news or greatly improved. A technically new product or process is one that technological features or intended uses differ greatly from the products and process ready made. A product or process technically improved is

one that its performance was greatly improved or updated (PINTEC, 2005).

The innovations in products and process may result in great benefits to the company. The main benefits are in Table 1.

Although the terms adoption and diffusion of technology be closely related concepts, they are not synonyms. In accordance with ROGERS (1995), diffusion is the process by which the innovation is communicated through the years by channels, among the members of a social system.

To HOYER & MACCINIS (2001), while diffusion reflects the behavior of a takers decision group, the adoption reffers to a individual behavior. Thus, the diffusion represents a macro process, while adoption is a micro process that focalizes the acceptance or rejection of a innovation by a company.

The adoption of technological innovation involves a process of decision in which the cognitive elements of the behavior of the adopter company predominate for its explication. The process includes five steps: knowledge, persuasion, decision, implementation and confirmation.

In accordance with ROGERS (1995), the step of knowledge starts when the company have got stimulus, incititing it to a technologic innovation. In the step of persuasion there is a shape of favorable or unfavorable attitudes in relation to technological innovation, bringing into connection the risk of the use of this innovation. The decision step involves the decision to choose between adopting or rejecting the technological innovation. The implementation step reffers to the effective use of innovation. The confirmation step searches to strengthen the decision for the already made adoption.

The measurement of the resources put by a company in the inovative activities reflects the strength invested to the innovation. In accordance to the informations of PINTEC (2005), the seven sort of activities with what a company can lead its efforts for innovation are:

- Internal activities of R&D - creative and systematic work aiming the increase and the use of knowledge to develop new applications;
- External acquisitions of R&D - the same activities of the last item, however realized by other organization and acquired by the company;

Table 1. Possible effects of technological innovation in products e process.

Products	Process
To improve the quality	To increase the product capacity
Enlarge range to available products	Increase production flexibility
To keep and enlarge market share and open new markets	To reduce costs by reducing energy and raw-material

Source: IBGE - PINTEC, 2003.

- Acquisitions of other external knowledgments - agreements of technology transference, or purchase of the rights of patents and use of brands and other kind of technical-scientific knowledges;
- Acquisition of machines and equipment - bought for implementation of products and new or technically improved process;
- Directed training to the development of products/ process technologically new or improved and related to the inovated activities of the company;
- Introduction of the technological innovations in the market - commercial activities, directed linked to the launching of the product technologically new or improved. It may include, marketing research, marketing test and publicity for the launching; and
- Industrial project and other technical preparations to production and distribution: procedures to bring about the implementation of product or process innovations.

2.2. Technological innovation in the food companies

In Brazil, the food industry comprehends small and medium enterprises (SMEs) distributed on all national territory. These companies operating in regional markets, while the large companies act in all over the country and some in the international market.

In accordance with the Brazilian Food Industry Association, in 2004, the food industry segment was composed by 40,000 companies, being that only 330 are big companies. At this time, the sector was responsible for 850,000 jobs, it was 10.4% of the total nacional production, a income about R\$ 180.6 billion.

The food sector has experienced important changes in the last years, in part because of new opportunities in the external market and by the strong presence of rivalry in Brazil. These were the main reasons for the food industry to modernize their production systems, adopting technology in their products and process.

Presently, the food enterprises find themselves in a position where technological resources are basic to face the challengies of the national and international competition, particularly in relation to the new standards of consumption, elapsed from the life style changes and consumer preferences.

The pattern of food consumption to be attended by the companies brought alterations in the technological pattern of the Brazilian companies. The most meaningfull features of the food enterprises in relation to innovations are in the Table 2.

The process of technological innovation in the Brazilian food industry is a process of the technology diffusion and not a internal process in the companies of innovation

Table 2. Features of food companies in relation to innovation.

1- The internals features of the companies and of the internal consumer market have strong influence in the food industry about innovations
2- In this segment the innovation of process to the companies prevails
3- The more productive enterprises use as principal source of innovation the consumers and the clients
4- Questions related to the distribution are as important as the effort to innovation on the production
5- Public politics related to the consumers with low purchasing power may produce a indirect effect in the stimulus for innovation
6- In Brazil, the requires for competitiveness in the agri-food sector are becoming more and more sophisticated
7- The educational level of professionals shows great importance in order that food companies may develop their inovatives activities

Source: CONCEIÇÃO & ALMEIDA (2005).

development. CABRAL (2001) reports that the technological innovations in the national food industries are concentrated in the production process (57.2%), in the products (33.3%) and in the combination of process and products. This last innovation happens when innovations in the process make possible the development of new products.

The modern technological innovations of the food industries aim the increasing of productivity and the appreciation of the product. In order to attend this request, such industries have used equipments more sophisticated, allowing schedules to processing different products without changing the line of production, as more asseptie due to decreasing of direct handle of the product, reducing the contamination level. Another common strategy is to adjust the existing machines and equipment on the plant. The objective of these adjustments is to increase the company productivity and to reduce costs, increasing competitiveness in the final price of the product (SANTINI et al., 2005).

Projects aiming the improvement of the products have been found the most common way to appreciate the product. These projects can be classified as new projects for the company or new projects just for the market. The new project to the company is one which is already available in the market, but isn't part of the portfolio of the company. The new project to the market has more degree of innovation, the risks and costs are bigger, but the product find a market free from competition.

In a study achieved with 25 companies of food sector, TOLEDO et al. (2005) reported that 4.6% periodically modify their products, 56% launch new products, although they exist already in the market, and 52% develop products really new.

The enterprises size and their will to export, also are very important in its capacity to develop new products. The authors report that 37.5% of the companies with less

than 500 employees launch new products to the market, while the dynamic to innovation to new products in the big companies reaches 61%.

The greatest dynamic for innovation is also observed in the companies that export, since that 91% of them change their products periodically, 63.6% launch new products only for the enterprises and 54.5% develop new product for the market.

However, the greatest part of the products developed by the food companies are the extension of line kind. FULLER (1994) describe this category as projects that demand little time and effort to their development, and doesn't require changes in the line production, acquisition of new equipment and they need little change in the market strategy.

In the companies of food sector the product development must be strongly linked with the strategic vision of the company, including, therefore, cost of development, condition needed to reach technology, fitness to the consumer needs, etc. In this segment, the requirements are greater, because beyond to attend market demand it is necessary assure the safety of the food, as much in the production process, as in the final product ready to consume.

CLELAND & IRELAND (2002) surveyed a set of variables that affect the development of new food products. The main factors of success of new products were: 1) economical factors related to the final price and to the cost to produce it; 2) market aspects, as the consumer needs and the access to the distribution ways; and 3) to control the technology. The reasons of the failure are related to lack of compromise of the high administration in the process of the product development and the time for it. BACK & FORCELLINI (2002) report that due to the dynamic market, the more is the time for developing and launching the product, the more will be the unsureness of success.

Another factor of success is the use of a formal process for the development of the product. Although the literature shows many models of reference specific to food, this is not a way frequently used by the companies of this sector.

In accordance with ROZENFELD et al. (2000), the reference models are representation of the process of business that describes their many dimensions, as activities, information, resources and organization. Such representations work as reference so that the companies can plan, control and manage the development of the product.

These methodologies seek to offer to the team of project a reliable model, with recommendation and tools that help to do their activities, beyond its approach to be directed to the features of the development of the product of food industry.

In the food industries, beyond the product development, the project process takes a particular importance. The transformation process are responsible by the introduction of new products, due to they cause changes in the food in its

chemicals features, physical, organoleptical and nutritional features, changing their initial quality pattern.

New process of transformation can supply new products, with more appreciated, attending the consumer's needs. However, it was verified that the most part of the product in the market are extension of line kind, produced by universal manufacture system. This situation happens by unknowledge of specificities of the process project. The methodologies of the project are directed to "what to do" leaving as second plan "how to do".

As a general manner, it is necessary that the food Brazilian industry jump competitively toward the innovation and differentiation of their products. In accordance with CRIBB (2004), in order to the food segment incorporate effectively technology in its process of products development, the sector need to pass by frequents rearrangements, in order to follow the dynamic market evolution.

2.3. Cooperative arrangements

In accordance with TETHER (2003), many companies shared collaboratives agreements due mainly to the fact that they don't have all the needed resources, including the knowledge to adopt and transfer the innovation to their products and process, and/or because they will to reduce associated risk to the innovation.

The cooperation may happen among clients or consumers, suppliers of machines and equipments, others companies of the group, competitors companies, universities and institutions of research, consulting companies, capacitation and technical assistant center, institutions of tests and certification, and classes association.

The IBGE reported, based in a set of indicators to the industrial sector, from the PINTEC 2003, that the companies cooperate a little. With the research institution the cooperation is smaller than that, about only 3.4% companies, so the technological innovation process in the Brazilian food companies is specific of the company.

A minority of the Brazilian companies are compromised with a relation university-company. Some of them doesn't need to do cooperation with universities and research centers, and the others don't have the ability needed to do so, mainly in human resources.

The collaboration is a little realized among the companies. Despite the direct competition among the companies, in the situations that the development of the product and the service are easy to be copied, but expensive to be developed, the cooperation can succeed, because they are linked to the patterns and their common interests. The companies need to know the strength and weakness one to each other, finding areas where their strength are complementary to the development of a new extension of the product. For this reason, the collaboration among

competitors must be stimulated when they are all faced with a common problem.

In accordance with CASSIOLATO et al. (2005), specifically related to development of new products, the cooperation shows the following characteristics:

- The cooperative process are very little meaningful, regardless of the category of the company;
- There is a generalized tendency of the companies, regardless of the category, for use external sources;
- The companies that inovate more use meaningfully other company of the group as partner; and
- The companies that inovate a little use as main source of innovation, another companies and research institutes.

In general, although the participation of the national companies in cooperatives arrangements is small, there is space to build up the cooperation, mainly in regions that are already advanced in their local productive systems. The companies need to enlarge their internal knowledgement base in order to develop products more innovatives and the cooperation allows knowledgent transfer among organizations.

3. Presentation and analysis of the results

Beyond the informations related to the incorporation of new technological innovations to the development of new products and process, this item also reports the ways of cooperation established by the companies and the other organizations, including in this description the kind of capacitation used. It is part of innovations effort the capacity of the companies to establish alliances of cooperation to the technological innovation of their products.

3.1. Development of new products and process

From 2003 to 2005, the studied companies realizad many activities of research and development toward the development of new products, including prototype construction an tests, projects of new process and software acquisition.

When the development of new products was oriented to attend the export, beyond the attendance of consumer needs, the appreciation aimed to compensate the problems caused by the exchange variations. Within such projects, what really happened was the development of new tastes, different shapes, sizes and new packages. These products can not be considered as greatly improved, as defined by the PINTEC (2005). An exemple of this situation is the development, already in the test phase of the prototype, of a new caramel stuffing for the tablets with chocolate cover.

Although the inicial intention of the development was the export, the developed product was also worked for the internal market. At the launching of the product in Brazil, the

activities of marketing were thought again by the company, that adopt the research and tests of market as essentials tools. The marketing research was realized together with the commercial representatives of the companies, that set the marketing area in relation to the competition. The marketing test was realized by tasting the products in strategical sales points.

Therefore, an evolution in regard to identify the consumer opinions, however this process isn't yet realized in a suitable way, above all in a market where innovations are strongly influenced by the consumers. In these companies prevails the opinion of the high administration about the course of the product innovation.

The new product generate meaningful changes in the production organization. It increased the sales in the nacional market and the company become to use 100% of its line production. The export sales arouse from 10% to 30% in three years in one of these companies.

In order to improve the precess machines were purchased to accomplish the dosage of the chocolate bar. The benefits of this acquisition were the elimination of waste in this dosage, consequently, reduction of costs improving product standard, improvement of quality and increasing productive capacity.

During the establishment of the new technology were needed orgaizational changes in order to succeed. The main changes were:

- Changes on the physical space and plant layout fitness;
- Production process changes: management of quality and management of production tools were introduced;
- To enable the staff: mechatronic, operation analysis and process engineering training; and
- Quality patterns changes: the quality system improved continuously, establishing new patterns, creating a certification to the raw-materials suppliers, within company especifications, by external audit.

So a new product change the routine of a company, causing a series of transformations. For this reason it is recommendable to use a reference model, that systematize the steps of the development. None of the companies use a formal process to orient the development of their products.

As a general manner, it was possible to observe that the innovations of the process were toward the cost reduction, associated to the diffusion of the technology already existing in the market. In relation to the innovation of the product, it was observed that the companies inovate a little due to a small scale of production or because they don't identify this need, because of the stability of their products in the market were they act.

The companies that look for cost reduction, generally make innovations that come from the availability of the model of the machine or equipment, than a project planned by the company.

Therefore, a new product can be made when a machine is bought, seeking reach new markets.

In general, the innovation of products and process, even with low intensity, brought positive results to the companies, since that it improved the product quality, increased the participation in the market and reduced processing costs.

3.2. External cooperation to innovation

The concept of cooperation referring to innovation indicate that there must exist active participation in combined project of innovation with other organizations. But the benefits may not be immediate.

The simple contractation of services from other organization, without its active collaboration, is not considered as cooperation (DE NEGRI & SALERNO, 2005).

Therefore, the procedure used by the companies of the sample can not be considered a cooperative arrangement, but a way to seek help, outside the company to develop their products and process.

The companies seldom innovate alone. Therefore, two of the studied companies made forms of cooperation with foreing, more specifically with foreing consulting specialized in development of food products. The option for this partnership was due mainly to two factors: safety and time.

The safety, in the sense of developing a project of the product with reduced margin of error and within the standard of quality required by the market and time by the necessity of launch faster new products. The knowledge and technological transference by partner company made it possible to attend these two situations.

The companies have realized consults with universities, although not frequently, placed near to the plant. An exemple was the parcial automation of the line production of a company, aiming reduce waste that happened during the process. This innovation in the process, beyond to reduce costs also improved the quality of the final product.

Students training in the company were another way of relationship with the university. During the training the students realized the conclusion work of the course studing a critical problem in the company. The development of new products sector had been very seeked for this.

The companies of this sector use very little this is a way of cooperation, since that only 11% of the national companies show some way of coloboration with others organizations seeking innovate their products and only 3.4% of the inovative Brazilian companies cooperate with research institutes and universities. However, a

great potential for improve cooperative relationship with technological innovation with universities and research centres was observed.

The cooperation with suppliers happens in the three studied companies. The motivation for this happens by the innovations in raw-material, inputs and equipment. For the new equipments, the suppliers generally dispose technicians to follow the process and to train the staff to use the equipment suitably.

The cooperation can also be developed seeking to enable the staff, especially, of the group in charge of the development of the product. In this case, the cooperation happens only in one of the company of the sample, possibly due to the fact that it shows a greater participation in the external market, therefore, they need more specific knowledgement about the process.

These companies show in their portfolio products that are delivered to the consumer countries and are developed according with their habits. Certain consumer standards exist for a long developed time, requiring a great effort to be modified. An exemple of modification in the product due to consume habits change, can be seen in the different tastes developed for the products, acquired from the changes in the sugar content.

A step of the development process that requires training was the equipment development used for prototype tests that was possible due to enable technicians in the mechatronic area. The advantage of this procedure was observed in the time reduction of development and product finalization.

The most utilized ways to seek new knowledgments happen by technical travels, workshops and technical fairs in Brazil and abroad. The result of this seek was the acquisition of one of module ERP (Enterprise Resource Planning) of coorporative manegement and industrial maintenance for one of the companies.

The benefits of this acquisition were the complete monitoring of the maintenance and project services, information about costs in realtime, meanifully productive gain by elimination of stops not expected of machines and equipment and increase of control of interchangeability of piece and machine. Beyond of being a tool directed linked to the productive process, the company obtained others benefits, as the gain of an international certification of total quality, allowing to export their products to USA.

Another source of new knowledgments was the contract of a German consulting for development of new product and process in the food area, which acted in one of the companies for three years. Among the advantages as consequence of the partnership, detach the change in the image of the product, improving the brand in the market.

The others companies from the sample, although don't enable their staff to the development of new products, realized training with the objective of develop knowledges

and skills needed to control the technologies and process, that also are useful to the project of the product. It was realized training about Good Manufacturing Practice, Good Environment Practice, Use of Equipments for Individual Protection, Hazard Analysis and Critical Control Points (HAPCC) and Electronic Instrumentation. In one of the companies, happen 236 internal events, with total of 3.094 hours of training.

In spite of the studied companies utilize little knowledge of external sources, this kind of collaboration has grown. Two of the companies are in a region considered industrial center of food production, with potential to form cooperatives net for innovation of products and process.

4. Conclusion

With the fast transformation of the markets and the high rate of technological changes, the companies that want to keep or to increase their position in the market must innovate their products. They need for it to be pro-active and to develop meaningful changes, and transform the existing structures.

It was observed that in the studied companies, the effort for technological innovation of a new product is much reduced. Actually, there weren't launch of product from 2003 to 2005, of which technical characteristic or the intended uses greatly differ from the existing products. What happened was the launching of products with improve performance, the companies introduced innovations that are news to them, but aren't for the market that they act. The innovations that are pioneer only for the company are much more near to the concept of diffusion of innovation than the concept of real innovation.

For products destined for export, the main changes were related to the taste and package, of which its objective was the fitness to the habits, custom and legislation of the import countries. The changes in the packages happened with the objective to become them more convenient, making it easier to open and close. The graphic elements also were improved, detaching the introduction of more attractive colours and showing the identity of the company.

The most meaningful innovation was of the process. This doesn't mean that they aren't important, but it is desired that the companies innovate also in products or, at least that the innovations in process to be used to develop new products.

The adoption of process technologically new or greatly improved, including acquisition and/or changes on equipment, resides have promote the development of new products, allowing also a better organization of production, with improvement in the quality and process speed.

It was possible to observe a great effort to seek new knowledge. The main sources were external, by consulting and participation in fairs, events and international

technical visits. In the food products segment, the launch of new products, although with increased changes, is very intensive, so that the companies developed the habit of following the constant launch of products, identifying the incorporated technologies.

The investment in consulting shows the effort that these companies undertake to seek for improvements in the production process with results in the products quality. The training of the staff showed this fact, that for the studied companies, overtook the operational question, and contributed to create a organizational environment that the staff felt motivated to cooperate with the company, avoiding work accidents and production process gaps and administrative gaps. A channel for the staff suggest improvements in the way to realize the tasks was done by two of the studied companies.

The three major difficulties to adopt the technological innovations were: high costs for development, associated risks with the country economy (interest rate, exchange and inflation) and low acceptance of the consumers as related to the new products.

The argument that the costs to development of the new products can be contested by the fact that two companies of the sample count with the assistance of specialized institution of food technology, specifically with products that integrate the portfolio of these companies. As the agreement with the organizations is recent, the tendency is to have an approach between them to develop innovative products with a reasonable cost.

The associated risks to the country economy are related to the uncertainty of return of investment due to three reasons: 1) high interest rate that reduce internal consumption and high cost to finance modernization of industries; 2) unstable exchange that prejudice the export; and 3) excessive income tax.

The low acceptance of consumers related to new products happen due to the high price of these products and not due to flavor, shape, color and packing. In this segment, the consumer doesn't accept the increasing of price in regard to changes in the product.

Other difficulties to the technological innovations were the legal requirements related to fitness of standards, rules, rigidity to change due to management resistant, lack of specialized technical services, lack of qualified personal and absence of information about the technology to be adopted in the process to development of products.

The technological innovation represents an essential tool for the companies to reach competitive advantages, as to the launch of new products and the improvement of the already existing. Therefore, the technological innovation increase the competitiveness of the company only if the results of the technological projects were effectively

incorporated to the products and brought to the market before the competition.

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