

QDSnacks®: the future of meat snacks now

Daniel Sanz, Francesc Castells, Llorenç Freixanet, Josep Lagares



New food trends have led consumers to seek new types of food and snacks to eat between meals: healthier, rich in protein, low in carbohydrates, trans fat free... although without forgetting that this kind of consumption is often done impulsively in search of a pleasurable moment.

With these points in mind and in an effort to meet this challenge, many meat producers have started to get interested and consider entering the world of meat snacks. It is not just a way to meet a growing market demand, but also a way to differentiate oneself from the competition, diversify and open up new market possibilities.

This article analyzes the evolution of meat snacks and introduces some new and innovative products developed by QDSnacks® technology. This technology enables processors to industrialize, optimize and innovate in the world of meat snacks in a way that up until now, and with existing technologies, has not been possible. As a result, you can observe the multiple advantages and options for innovation that this technology offers in comparison to other current processing systems. You can also verify, by means of the characteristics and various meat snack options developed, that this challenge to satisfy the current growing market demand for snacks can be met.

INTRODUCTION

Today global sales in snacks exceed 374,000 million dollars annually. Europe (with 167,000 million dollars) and North America (with 124,000 million dollars) account for most of the sales worldwide.

In recent years the habits of Americans have evolved toward the search for healthier products and this has probably had a strong impact on new trends in food, as published in the Packaged Facts article, Sweet baked goods: U.S. Market Trends, in 2015. At the same time, the same article states that the US is becoming a nation

of snack consumers, with two thirds of adults admitting to a regular consumption of snacks between meals in 2015. As indicated by Packaged Facts in its article, many Americans, especially young people, have even begun to replace some of the most common meals of the day with snacks.

As can be seen in figure 1, salty snacks were in first place, in 2014, in the North American market, while they occupied third place in the European market, according to the publication “The Nielsen Company: What consumers are reaching for around the world”.

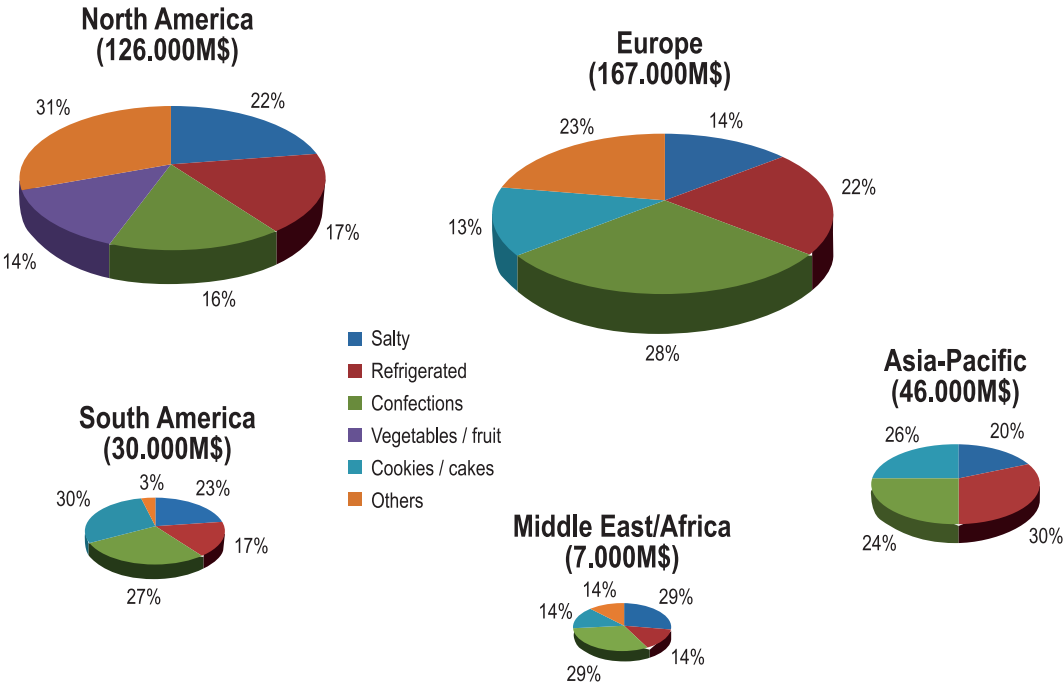
Meat snacks are included within the general designation of “salted” and this type of product ranks as the third most consumed salty snack in the US.

North America dominates the global market of meat snacks, mainly in the form of jerky products. Because in recent years manufacturers have redirected the image and vision of these products toward the healthy snack, while improving packaging and providing a wider range of choices and flavors, sales have grown and greatly increased according to new market data provided by Innova Market Insights (IMI) in 2015.

Nielsen, in 2014, published data indicating that meat snacks grew by 15% in North America and by 25% in Africa and the Middle East. According to IMI, underdevelopment of this market outside the US opens a wide range of opportunities for international growth.

In Europe, being a more traditionalist region, the market for meat snacks is poorly developed. Practically the only products to be found in this format are traditional cured sausages in a smaller size, as can be observed in figure 2. These are products such as small-format Salami or Pepperoni. This type of snack has been growing in volume during recent years, especially in central Europe.

The current trend toward a preference for healthier low-carbohydrate products, and the consideration of protein as a good source of essential nutrients, has resulted in an increased consumption of meat-based protein snacks.

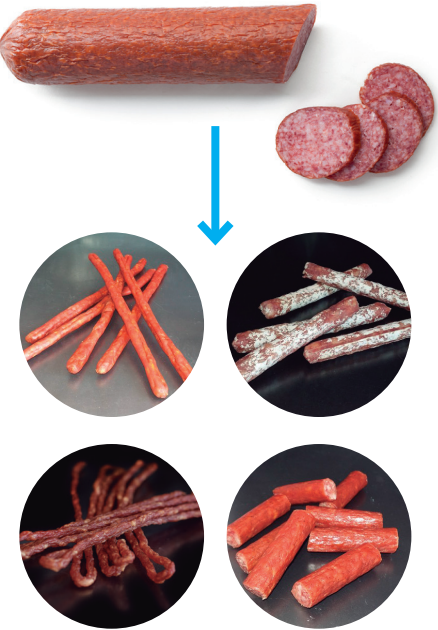


▲ Figure 1. Table of annual sales at the end of March 2014 [information taken from The Nielsen Company].

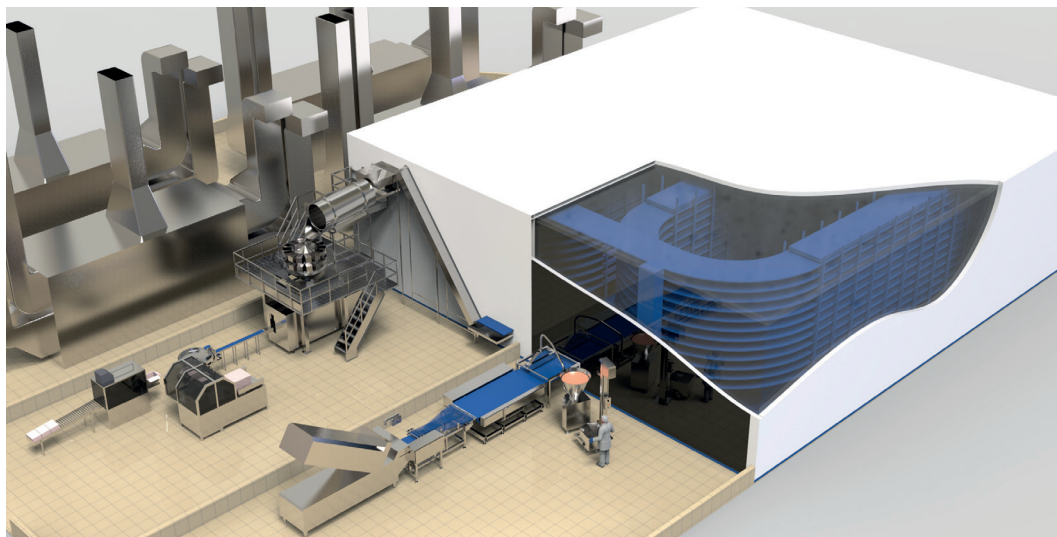
The market share of such products has increased thanks to being a value-added product (energy, essential amino acids, vitamins, iron...) without empty calories. They contain proteins of high biological value and are seen as “healthy choice” products.

MEAT SNACKS: NEW DEVELOPMENTS

The QDSnacks® system is an evolution of the QDS Process® [Quick Dry Slice process] system, which in turn is a disruptive technology of quick drying for cured sliced sausage based on improved efficiency of drying time, since instead of drying entire bars, the cured and fermented product is dried once it has been sliced so that drying time goes from some 40 days to about 40 minutes, thanks to a greater drying surface per unit mass as compared to the traditional method of drying whole unsliced bars. The process begins with making the meat product bars, followed by fermentation and, once the desired pH has been reached, freezing of the product until it acquires the



▲ Figure 2. Snacks that predominant in Europe.



▲ Figure 4. QDSnacks® installation.

necessary consistency for slicing. Once the product has been tempered, it is sliced and proceeds to undergo QDS® drying where, in a matter of minutes, the finished product is obtained, ready for packaging and sale. This system is, in turn, the theoretical basis of QDSnacks®.

QDSnacks® (figure 4) is a patented technology developed specifically for the rapid drying of meat snacks. As with the QDSProcess® system, the starting point is the production of the product base. Then, and depending on each type of

snack, the product can undergo various pretreatments such as fermentation, cooking or simply starting the drying process. In the case of having undergone a treatment prior to drying, and whenever necessary for stabilization or improvement of the subsequent cut, the product can proceed to freezing. Finally, the product can be cut to give it the desired shape and size before proceeding to the QDSnacks® drying process where, once finished, the snacks are ready for packaging.

It is a continuous and automated process that by means of synergy, as can be observed in figure 5, between the product pretreatment, freezing and QDSnacks® drying treatment allows for exponentially accelerating the generation of new snack products and formats. Freezing prior to QDSnacks® drying provides the process with great versatility and functionality. Not only does it allow you to have stock on hand and ready to be transformed into finished product whenever required, it also enables you to take the product to the limit during previous phases and stabilize it later. In the case of fermentation, for example, it makes working at relatively extreme temperatures and humidities possible, unthinkable in traditional methods, since once the desired pH and



▲ Figure 3. QDS®.

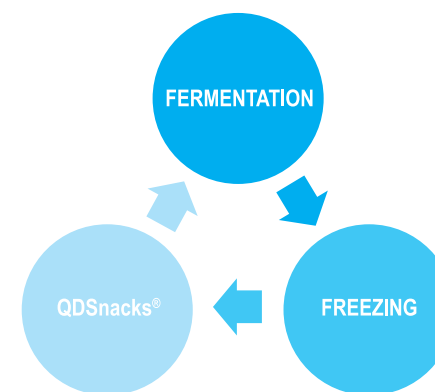
curing degree have been reached, freezing the product prevents it from suffering any changes or evolution.

The range of temperatures and humidities at which the system works has allowed for creating a niche and finding differential products of high added value that, due to their physicochemical and organoleptic characteristics, need these drying conditions. Unlike current methods, this system allows you to work continuously and automatically at temperatures of between 18 and 60°C, and relative humidities of between 5 and 25%. The fact of being able to use different temperatures and humidities in the process itself, and the ease of being able to change from one to another, makes the process highly versatile and capable of producing a variety of different products.

This exponential synergy, together with the know-how developed, allows for producing new and innovative meat snacks that are stable at room temperature, personalized in texture, flavor and aroma for each type of consumer.

The initial concept has been developed along three basic lines of meat snacks:

- Dry meat
- Extruded products
- Crunchy chips



▲ Figure 5. Triangle of exponential synergy.

Dry meat

A classic concept for this type of meat snack is beef jerky. Jerky is a very common product in the US and is growing in popularity worldwide. Traditionally it is based on marinating meat that is cut in thin strips, cooking and subsequent drying to levels of water activity (Aw) that allow the strips to be conserved at room temperature. This process, in general, is poorly automated and, although some big producers are currently working in a more industrial fashion by injecting a curing solution into the meat mass with subsequent massage in a drum, the drying process requires manual placement of the meat strips in trolleys, either on trays or sticks. This involves a great deal of manpower, and the product must be produced in batches that are small enough to be handled manually.

Considering these shortcomings of the traditional process, the QDSnacks® system developed by Metalquimia consists in automating the process, increasing productivity of these lines, while obtaining multiple different types of snacks from the same base.

The basis that was used for the process was the recommendation of the Food Safety and Inspection Service (FSIS), branch of the Department of Agriculture of the US government (USDA), according to which a thermal treatment must be carried out initially, one sufficient to reduce the level of pathogens down to a point where the subsequent drying results in a products that is safe and stable (FSIS 1999).

Based on this type of product, the “toppings & dippings” line was developed, of which an example can be seen in figure 6, and which is made from a base of lean meat material, stabilized, pasteurized and subsequently frozen and, just prior to the QDSnacks drying process, is given the desired shape. Different aromas and/or spices are uniformly applied, depending on the variety to be packaged (e.g.: spicy, Teriyaki, TexMex...), and the drying process by means of QDSnacks technology is performed continuously and automatically.



▲ Figure 6. Snacks developed by Metalquimia. Pork cubes (left) and turkey jerky (right).

This new concept opens up the possibility of starting with a single generic raw material (RM) and then, by means of the QDSnacks® process, differentiating the finished product depending on the type of cut (strips, cubes, laminas), as well as the spices and/or aromas



▲ Figure 7. Diagram of the process.

added in accordance with the variety to be produced. This represents a major advantage in logistics and planning, allowing you to work with the same generic base to continuously and automatically produce a specific product type on demand. This flexibility provided by the QDSnacks® system is also essential for any snack line which must constantly meet changing market preferences.

The continuous drying process in the QDSnacks® system is short (<3 hours), thereby preventing the product from suffering any deterioration. The range of mild temperatures together with low humidity levels provide optimum conditions for ensuring a snack with firm texture, appropriate size, and improved appearance and flavor.

Water activity (Aw) is the main barrier of this finished product. That is why this drying process is performed until obtaining an Aw < 0.85. In this way, according to American FDA guidelines, the growth of pathogenic microorganisms becomes impossible and stability at room temperature is ensured throughout the product's shelf life in a modified atmosphere packaging (MAP).

The product can be directly packaged and marketed for consumption, and can also be aimed at different market strata and used to create new references through mixtures with other dry food (vegetables or meat), as can be observed in figure 9. The only requirement is that the products in the mixture must have the same water activity and moisture content.

Water Activity (Aw)	Microorganism		
	Bacteria	Molds	Yeasts
0,97	Clostridium botulinum E Pseudomonas fluorescens	-	
0,95	Escherichia coli Clostridium perfringens Salmonella spp. Vibrio cholerae	-	-
0,94	Clostridium botulinum A, B Vibrio parahaemolyticus	Stachybotrys atra	-
0,93	Bacillus cereus	Rhizopus nigricans	-
0,92	Listeria monocytogenes	-	-
0,91	Bacillus subtilis	-	-
0,90	Staphylococcus aureus (anaerobic)	Trichothecium roseum	Saccharomyces cerevisiae
0,88	-	-	Candida
0,86	Staphylococcus aureus (anaerobic)	-	-
0,85		Aspergillus clavatus	-
0,84		Byssoschlamys nivea	-
0,83		Penicillium expansum Penicillium islandicum Penicillium viridicatum	Debarymoces hansenii
0,82		Aspergillus fumigatus Aspergillus parasiticus	-

▲ Figure 8. Table of relationship between Aw and growth of microorganisms.

Extruded products

Starting from the premise that in Europe the fastest growing snack is the traditional product in a smaller size and format, an effort was made to find the most efficient way to produce these mini salamis and, at the same time, further reduce the size of this product without losing its similarity to the original product. This represents an evolution of meat sticks of sausage,

kabanos or salami, but in sizes between 3 and 10mm that are stable at room temperature.

These are products with high protein content and, depending on the variety, may contain a higher or lower level of fat. These sticks and bars are the type of meat snack that in shape and flavor most resemble the traditional product and that the consumer associates most easily with a traditional product.

▼ Figure 9. Mixtures of QDS meat snacks with dried fruits (left) and nuts (right).





▲ Figure 10. Salami-type sticks (left) and meat bars with nuts (right).

Generally, for the production of these snacks, stuffing by means of co-extrusion is used with a solution of alginate or collagen from the meat batter prepared initially. After stuffing the product proceeds to fermentation, drying and, finally, weighing and packaging. The customary drying period is more than 3 days and, in general, is a poorly automated process done in dryers specially adapted to low heights and specific air distributions, which makes them less flexible in regard to adapting to other productions and incapable of handling high production outputs, due to the limited product load imposed by the m3 of drying space.

Initially an effort was made to obtain a more automated and efficient process, and toward that end a continuous process was developed, one fast enough to be able to obtain a product ready for packaging in a period of time less than the standard duration of a work shift in the meat industry; this process consists in preparation of the initial meat, direct extrusion of the same, QDSnacks® drying (with cooking and smoking as optional preliminary stages) and, finally, weighing and packaging of the product. The entire process is performed automatically and continuously in less than 5 hours from start to finish. In addition to the logistical advantage this represents, since the process starts and finishes within a single work shift and production can be adapted to a wide range of types and formats, thanks to direct extrusion

of the thin sticks no fibrous casing of any sort is needed, generating savings both in stuffing material and investment in systems of co-extrusion. There is no need for fibrous casing when using the QDSnacks® drying process, since the layer of dry protein that forms immediately around the product helps maintain its shape and consistency.

During the QDSnacks® drying process a wide range of temperatures can be used, to obtain the desired texture and reach a stability low enough to provide product stability at room temperature. The drying process can be combined with other inline treatments such as cooking or smoking.

TRADITIONAL	QDS
Preparation of the paste	Preparation of the paste
↓ Stuffing (with casing or co-extrusion)	↓ Extrusion (without casing)
↓ Fermentation and drying (3 – 21 days)	↓ Drying (< 4 hr) with optional cooking and/or smoking
↓ Dosing and packaging	↓ Dosing and packaging

▲ Figure 11. Comparison of traditional process flowchart with QDS system.

Crunchy chips

The texture of food, and above all of snacks, is increasingly important among a growing sector of consumers such as young adults (Sloan 2013). Texture is increasingly perceived as an indication of the product's qualities and, among these, a crunchy texture is increasingly important in the sector of snacks since, for example, potato chips are one of the most widely consumed snacks on a global scale and rated first in the US (Nielsen 2014).

Based on this trend in consumer preferences, the appropriate technology was developed in the QDSnacks® process for drying thin slices of a cured product. The thin slices are made from a base of lean meat that resemble traditional chips in shape and texture, but with very different flavor and nutritional characteristics, since they are made from a meat base rather than starch and therefore are high in protein and low in carbohydrates. In addition, since in the QDSnacks® process the product is dried by means of controlled convection rather than fried in oil, it contains fat percentages well below those usually found in fried snacks.

The organoleptic characteristics that give the finished chip its desired texture are developed in the process prior to the QDSnacks® drying. This system allows for applying both fermentation and cooking before drying. This preliminary step is especially

important for the development of texture in cured uncooked chips, since prior parboiling with selected strains of Micrococcos will generate the proteolysis necessary so that the chip, once in the mouth and rehydrated during mastication, will not regain the typical rubbery texture of dried meat.

The texture of cured chips is developed by means of applying an intense proteolytic fermentation during parboiling, which can be fully controlled since, once the meat mass is fermented, freezing and rapid final drying to very low Aw levels put a stop to any undesirable evolution of the product, thereby preventing chemical or microbiological degradations from taking place during the process, as may occur when using a traditional method. The fermentation process can also be started with very low levels of salt, difficult to manage with the traditional system, in order to avoid an excessive level of salt in the finished product after drying.

The fermented chips are dried by QDSnacks technology until a completely crunchy texture is achieved by using processing temperatures below the coagulation temperature of the myofibrillar proteins, thus preventing any change in texture of the cured product during mastication, while retaining the volatile aromas generated during fermentation. To obtain crispness, slicing is done at a thickness of less than one millimeter and the QDSnacks®

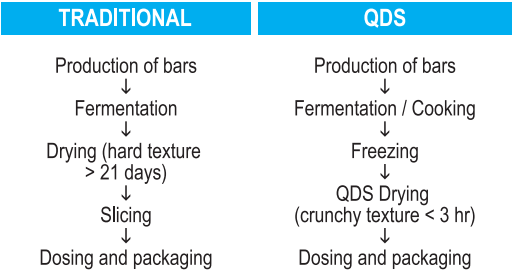
▼ Figure 12. Different varieties of extruded meat sticks.



▼ Figure 13. Fermented chips of chorizo sausage (left) and pork ham (right).



controlled convection drying provides for obtaining a more traditional appearance, which enables the production of chips made of cured ham or chorizo sausage, chicken, turkey, with and without smoking, etc. As in the production of classic snacks, flavors or spices can be automatically added inline to generate greater product variety from the same base.



▲ Figure 14. Comparison of traditional process flowchart and QDS system.

The texture of cured chips is developed by means of applying an intense proteolytic effect during fermentation, which can be fully controlled since, once the meat mass is fermented, freezing and rapid final drying to very low Aw levels put a stop to any undesirable evolution of the product, thereby preventing chemical or microbiological degradations from taking place during the process, as may occur when using a traditional method. The fermentation process can also be started

with very low levels of salt, difficult to manage with the traditional system, in order to avoid an excessive level of salt in the finished product after drying.

The fermented chips are dried by QDSnacks technology until a completely crunchy texture is achieved by using processing temperatures below the coagulation temperature of the myofibrillar proteins, thus preventing any change in texture of the cured product during mastication, while retaining the volatile aromas generated during fermentation. To obtain crispness, slicing is done at a thickness of less than one millimeter and the QDSnacks® controlled convection drying provides for obtaining a more traditional appearance, which enables the production of chips made of cured ham or chorizo sausage, chicken, turkey, with and without smoking, etc. As in the production of classic snacks, flavors or spices can be automatically added inline to generate greater product variety from the same base.

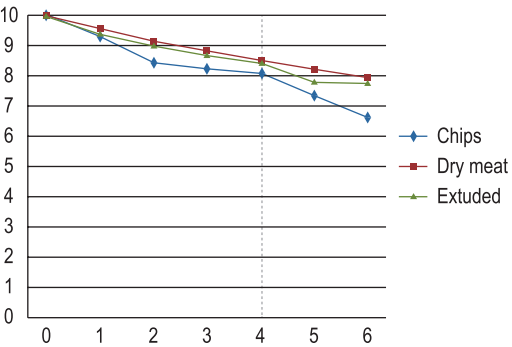
This product type is so hygroscopic – their moisture content and Aw are below 6% and 0.4, respectively – that packaging becomes a crucial element in ensuring organoleptic stability of the product after packaging. Proper packaging ensures that the characteristic crispness will be maintained throughout the product's shelf life, which makes packaging itself a vital part of the process.

▼ Figure 15. Cooked chicken chips (foreground) and fermented chips (background).



Shelf life of snacks

Various shelf life studies carried out at room temperature (25°C, 75% HR) ensure a shelf life of 4 months for all types of snacks developed and discussed in this article, when packaged in plastic of sufficient thickness (Figure 16). It has been shown that products with lower levels of drying, such as the snack lines of dried or extruded meat, can last up to six months while maintaining more than acceptable overall scores, although after this point progressive and accelerated loss of natural color occurs.



▲ Figure 16. Aging of the different meat snacks. Relation between score and weeks.

For products with the most loss, such as crunchy chips, it has been shown that packaging in a multilayer material with aluminum foil can extend shelf life up to six months without degradation of color and with better final scores of the product on the organoleptic level. This is possible because the metalized layer provides for maintaining uniform levels of residual oxygen during the entire shelf life.

CONCLUSIONS

For some time now it has seemed that the meat snack market was on the verge of a great emergence and diversification of products. But the truth is that so far the only product with a significant volume of sales is jerky made from different types of meat, mainly in the US.

The market studies carried out concur that this is a type of snack prone to exponential growth, especially in Europe where the meat snack market is underdeveloped because the products marketed are basically “take away” versions of the already-existing traditional product.

The salty snack industry has years of consolidation in highly developed markets and is growing in emerging countries. This adaptability is largely due to the flexibility and versatility of existing lines in this sector, where fried and baked products dominate, with processes that enable the finished product to be obtained within a few hours or minutes.

In contrast, the manufacture of meat snacks existing on the market today is done in conventional meat industry lines (ovens and dryers), with processing times that can last up to several days, and with the typical limitations on the fermentation and curing processes involved in the use of such installations, but with the added difficulty of controlling the drying climate with reduced formats and not making use of the treatment chamber's total volume.

The application of the production concept that QDSnacks® technology provides for the meat industry allows manufacturing lines to be organized in such a way that they can respond swiftly to changes in market preferences, but also be flexible enough to produce different product types and formats, as well as opening up new consumer habits by producing lightweight packages with a large number of easy-to-share units, or by introducing new textures for the sector such as crunchy meat chips.

This versatility and flexibility provided by QDSnacks® technology in the development and manufacture of meat snacks is a key element, but we should not forget another essential factor which is the packaging: both the correct selection of materials and the packaging method employed will not only affect the product's shelf life, but also provide a marketing edge, since the package plays a key role in the consumer's decision to buy a snack, which

is often bought on impulse.la introducción de nuevas texturas para el sector como pueden ser el chip crujiente.

BIBLIOGRAPHY

- THE NIELSEN COMPANY. September 2014. Snack Attack, What consumers are reaching for around the world. Disponible en: <http://www.nielsen.com/content/dam/nielsen/global/kr/docs/global-report/2014/Nielsen%20Global%20Snacking%20Report%20September%202014.pdf>
- WOOLLARD, D., 2014. Overcoming the Health and Taste Challenge in Snack Food Manufacturing. Food Marketing & Technology key no. 83778.
- FOOD BUSINESS NEWS. 2014. U.S. market for meat snacks continues to evolve. Disponible en: http://www.nxtbook.com/sosland/fbn/2015_08_25/index.php?startid=13
- NAUTRACEUTICALS WORLD. 2015. Meat Snacks Gain Momentum with Protein Positioning. Vol. 18 Issue 7, p14
- FSIS, 1999. FSIS Appendix A: Compliance Guidelines For Meeting Lethality Performance Standards For Certain Meat and Poultry Products. Disponible en: <http://www.fsis.usda.gov/wps/wcm/connect/212e40b3-b59d-43aa-882e-e5431ea7035f/95033F-a.pdf?MOD=AJPERES>
- FLORES, A., 2013. QDS Process: de la Tecnología a los Modelos de Negocio. Metalquimia Artículos Tecnológicos p225-231
- COMAPOSADA, J., 2103.Vida útil de embutidos fermentados producidos con la tecnología QDS process®: estudios de caso para pepperoni estadounidense y salami alemán. Metalquimia, artículos tecnológicos.
- NAUTRACEUTICALS WORLD. 2015. Protein Positioning Helps Meat Snacks. Disponible en: http://www.nutraceuticalsworld.com/issues/2015-09/view_

breaking-news/protein-positioning-helps-meat-snacks-maintain-momentum/

- REGLAMENTO (CE) no 2073/2005. 2005. Criterios microbiológicos aplicables a los productos alimenticios
- PACKAGED FACTS. December 2015. Sweet Baked Goods: U.S. Market Trends. Pub ID: LA5654968. Disponible en: <http://www.packagedfacts.com/Sweet-Baked-Goods-9524885/>
- WATER ACTIVITY (Aw) in Foods. US Dept. of Health, Education and Welfare Public Health Service Food and Drug Administration. Disponible en: <http://www.fda.gov/ICECI/Inspections/InspectionGuides/InspectionTechnicalGuides/ucm072916.htm>
- BARBOSA-CÁNOVAS, G., FONTANA, Jr. A., SCHMIDT, S. and LABUZA, T., April 2008. Water Activity in Foods: Fundamentals and Applications. Apendix D: Minimum Water Activity Limits for Growth of Microorganisms, p 405.
- SLOAN, A. E., November 2013. Consumers Have a Taste for Texture. Food Technology. Volume 67, No.11.

ACKNOWLEDGEMENTS

We would like to thank the Technology Department of Metalquimia for their collaboration in the development of this research, with special thanks to the laboratory personnel for all their help.