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Iberian pig production: The problems of success

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SUMMARY – The Iberian pig constitutes a singular breed, strongly adapted to the ecological conditions of the "Dehesa" ecosystem. This breed includes a number of strains, all of them showing low prolific and growth rates, very early maturing fat deposition, and an excellent meat quality, which is valuated in the market according to the fatty acid profile (palmitic, stearic, oleic and linoleic acids) of subcutaneous fat. This paper mainly deals with available feeding sources of the "Dehesa" for Iberian pigs, the productive features of this breed and the evolution that feeding and production systems have experienced in recent years.

Key words: Iberian pig, production systems, quality.

RESUME – *"Production de porc ibérique : Les problèmes du succès". Le porc ibérique est une race très bien adaptée à l'habitat de la "Dehesa". Cette race y comprend beaucoup de lignées qui sont toutes très peu prolifiques et ont un faible indice de transformation. Elles ont aussi un dépôt précoce de gras et une très bonne qualité de la viande très appréciée par les consommateurs. Pour évaluer cette qualité, on a fait le profil des acides gras (palmitique, stéarique, oléique et acide linoléique). Dans cet article sont traités différentes sources d'aliments qui existent dans la "Dehesa", valorisables par les cochons, les caractères de production et l'évolution de l'alimentation et des systèmes d'élevage pendant ces dernières années.*

Mots-clés : *Porc ibérique, système productif, qualité.*

Introduction

Productive systems based on autochthonous breeds and traditional extensive systems usually have big problems in the commercialization of the products, particularly during the initial stages of high scale commercialization. Atomized production and lack of uniformity makes difficult to reach big consumer markets.

The case of the Iberian pig is an outstanding exception among the many traditional productive systems in Europe. The peculiar characteristics of the breed and productive system lead to high quality meat products. The high acceptance of these products in the Spanish market has allowed the flourishing of a niche market, with increasing importance and very high profits. At the moment, around 2 million Iberian pigs were slaughtered in Spain in 2003 (MAPA, 2004), from which about 15% were fattened under free-range conditions, in which is called "montanera" (fed on acorns and grass in the "Dehesa"), and the other 85% were reared in confinement and fed on mixed diets. Based on these figures, the number of Iberian sows can be estimated in nearly 230,000, which means an increase in the number of reproductive animals of more than 100% compared to the year in which Spain joined the EU (1986). The Iberian swine sector includes a national association of farmers "Asociación Española de Criadores de Ganado Porcino Selecto Ibérico Puro y Tronco Ibérico" (AECERIBER) and four Protected Designations of Origin (Dehesa de Extremadura, Guijuelo, Pedroches and Huelva) which control the trade of high quality meat products (dry-cured hams and forelegs) elaborated under strict norms of animal production and industrial manufacture. Traditionally, carcasses of Iberian pigs were paid to farmers as a function of the genetic features of the animal (pure Iberian, crossbreeding of ¾ Iberian with ¼ Duroc, crossbreeding of ½ Iberian with ½ Duroc) and feeding system during the fattening, from 100 to 160 kg of live weight, including three different systems: (i) "montanera", in which animals are fed outdoors and consume exclusively acorns and grass; (ii) "recebo" (half the time in "montanera" and half time fed on mixed diets); and (iii) fed on mixed diets in confinement. There is

nowadays a Quality Norm for the production of Iberian hams, Iberian forelegs and Iberian loins (BOE, 2004) establishing that it is compulsory the use of pure Iberian sows if the meat products are commercialized as "ibérico". In addition, such Quality Norm establishes the existence of products of different qualities depending upon the feeding background of the animals ("montanera", "recebo" and on mixed diets in confinement). Moreover, since a few years ago, the payment in the trade of slaughtered Iberian pigs considers the fatty acid profile of subcutaneous fat, the range for each fatty acid within each commercial class is officially published each year.

However, this promising trend in the market of Iberian pig meat products has raised new problems of increasing importance: the imitation of the products and the rise of fake practices in the production and commercialization of the products. In this review we will present the peculiarities of the Iberian pig traditional productive system and discuss the new challenges arising. We believe it is a good example for many other traditional productive systems.

Free-range production

The production of Iberian pig is deeply bound to the Mediterranean ecosystem. It is a rare case in the world of swine production where the pig collaborates significantly in the preservation of the ecosystem. The "Mediterranean forest" is mostly composed of evergreen oaks (*Quercus ilex*), cork oaks (*Quercus suber*), gall oak (*Quercus lusitanica*), arbutus (*Arbutus*) and heath (*Ericeus*). In non-mountainous areas, where the density of trees is low and extensive animal production (cattle, sheep, pigs) have been commonplace for centuries, the Mediterranean forest is called "Dehesa". The available feeding sources for Iberian pigs in this ecosystem are the grass (from October to June), by-products of cereal crops and horticulture during summertime, non harvested figs and olives and mainly the acorns from trees of the genus *Quercus*, which are available from November to February. It is estimated that Spain has 2.9 million ha of evergreen oaks and 0.4 million ha of cork trees, of which 2.1 and 0.3 million ha respectively are forming part of the "Dehesa" ecosystem (MAPA, 2001). Of all this area, the surface used for Iberian pig production only represents around 450,000 ha, the remaining being used for bovine and ovine production, for hunting, etc.

Acorn production is highly variable, depending upon the year, the healthiness of the tree, its age, the tree management, the variety of tree and the tree itself (Vázquez, 1998). The "Dehesas" containing trees show an average density between 20 and 40 trees per ha, and the average annual production per tree is close to 15 kg, although in some cases the density is much higher (80-100 trees per ha) (Espárrago *et al.*, 1994). The whole acorn (shell, skin and endosperm) is not totally used by Iberian pigs. The shell and the skin, which constitute around 21-23% of the total weight of the acorn, are removed by the animal while ingesting. The endosperm of the acorn from evergreen oaks shows a 67% of dry matter (81.5% of nitrogen free extractives, 4.7% of crude protein, 6.3% of fat, 5.7% of crude fibre and 1.75% of ash on a dry matter basis) and is very rich in oleic acid (C18:1 n-9) (66% of total fatty acids), linoleic acid (C18:2 n-6) (14.7%), palmitic acid (C16:0) (12.6%) and stearic acid (C18:0) (3.2%) (Rey *et al.*, 1997), although its chemical composition is variable depending on the year and season. According to a recent experiment in which data from three consecutive years were recorded, protein, fibre, fat and oleic acid content of acorns increase during the months the "montanera" takes place (from October to February), while the stearic acid content decreases and that of the linoleic acid kept constant during such period of time (López Carrasco *et al.*, 2005). The grass in autumn and winter, together with the acorns, are the main natural feeding sources on which meat quality of Iberian pig is mostly sustained. Grass consumption is a very important source of protein (137 g/kg dry matter), linolenic acid (C18:3 n-3) (450 g/kg of total fatty acids) and α-tocopherol (171 mg/kg dry matter) (Rey *et al.*, 1997).

It is accepted that the Iberian pig is a single breed, but it includes a number of lines or strains with either red or black skin ("Negra Entrepelada", "Negra Lampiña", "Valdesequera", "Retintas", "Torbiscal", "Alentejano", etc.), all of them being perfectly adapted to the ecological environment of the "Dehesa". The average adult live weight of boars and sows has considerably increased in recent years, being nowadays around 140-170 kg for females and 180-190 kg for males (Daza, 2001). The first mating for sows usually takes place when they are 9-10 months old with 90-100 kg, while males reach puberty at 7-8 months of age. The productive live for sows in the traditional system lasts around 6 to 8 parities, while that of males is around 2-3 years. Iberian breed is not highly prolific (7-9 piglets per farrowing), the litter size increasing with the farrowing number, reaching the maximum between the 5th and the 8th one (Vázquez *et al.*, 1994). There are several factors that may influence this

variable, such as season (i.e. temperature) or feeding availability. Benito *et al.* (1992) found the highest prolificity in summer births, while Dobao *et al.* (1983) in winter. Suárez *et al.* (2002) observed that the strains "Manchado de Jabugo" (whose origin is the crossbreeding of Iberian breed with British breeds) and "Torbiscal" showed the highest prolificity, followed by the "Entrepelado" and "Retinto" ones, the "Lampiño" showing the poorest reproductive features. Crossbreeding between different Iberian breed strains improves the prolificity in around 0.5 piglets per litter (Silió *et al.*, 2001) and crossbreeding with the Duroc breed in 2-3 piglets (López-Bote, 1998).

Quality characteristics of the products

Growth and development of Iberian pig includes different periods, named "cria", "recria", "precebo" and fattening or finishing. During the "cria" phase (lactation and weaning) the piglet is nursed by the sow from birth (1.2-1.5 kg) to weaning, which is carried out between 28 days (6-7 kg) and 56 days (13-15 kg), depending upon the production system. From weaning to 90 days old (23-25 kg), piglets are usually fed in confinement, with mixed diets containing approximately 3100-3200 kcal ME/kg, 18-19% crude protein and 1-1.2% lysine. During "recria" (23 to 60 kg) and "precebo" (60 to 100 kg) previously castrated pigs are reared and fed in different ways depending on the system in which they are going to be fattened (outdoors in "montanera" or fed on mixed diets in confinement). Pigs intended for "montanera" are allowed to carry out physical exercise in farmyards or even using the available feeding sources of the "Dehesa", and are daily supplemented with 1.5-2.0 kg of mixed diets with 2800-2900 kcal ME/kg and 2.0-2.2% lysine per Mcal of ME (López-Bote, 2001), while those animals intended for being finished indoors on mixed diets, are usually fed in confinement and on a higher daily nutritive level, even *ad libitum*. The feeding level during the "recria" and "precebo" phases affects carcass quality and fatty acid profile of subcutaneous fat, and also to the content of tocopherols in muscle. Thus, Daza *et al.* (2005a) observed a compensatory growth during the finishing outdoors in "montanera", which mainly comprised fat, and higher concentrations of oleic and linolenic acids and of α- and γ-tocopherol in those pigs subjected to lower levels of feeding during "precebo" (Table 1). The recommended feeding strategy for Iberian pigs during the growing phases, despite the animals are aimed for being finished outdoors in "montanera" or in confinement, is a low feeding level, with mixed diets containing low fat, low linoleic and saturated fatty acid concentrations and a moderate high crude fibre levels, contributing to the development of the digestive system (López-Bote, 2001).

Table 1. Major fatty acid composition of subcutaneous outer backfat layer at slaughter and concentration of alfa and gamma tocoferol in *Longissimus dorsi* muscle according to the feeding level prior to free-range period

Fatty acid (%)	Feeding level		SEM	Significance
	High	Low		
C16:0	17.99	17.67	0.16	
C18:0	8.77	9.19	0.25	
C18:1 n-9	55.05	55.99	0.27	*
C18:2 n-6	9.42	8.68	0.35	(1)
C18:3 n-3	0.47	0.55	0.017	*
Σ n-6	9.57	8.82	0.35	(1)
Σ n-3	0.66	0.69	0.027	
Σ n-6/Σ n-3	14.80	12.82	0.62	*
α-tocoph (µg/g)	1.80	2.63	0.17	**
γ-tocoph (µg/g)	0.73	0.84	0.05	(1)

*P < 0.05, **P < 0.01, (1) P < 0.10.

The finishing or fattening phase (100-160 kg) is carried out either outdoors in "montanera" or in confinement with mixed diets. Genetic factors, and other aspects such as sex, age at the beginning of the fattening, age and weight at slaughter, environmental conditions, and so on, have marked effects

on productive results of this phase and on carcass quality. The "Torbiscal" strain shows the best carcass quality characteristics, while the "Negra Lampiña" one shows the worst, although the meat from this latter strain possesses an extraordinary quality, mainly as a consequence of its high intramuscular fat content and distribution (Benito *et al.*, 2000; Muriel *et al.*, 2004).

In production systems for growing-fattening in confinement, the crossbreeding of Iberian pigs with the Duroc breed improves average daily gain, feed conversion and carcass quality (Serrano *et al.*, 2005a,b), although meat quality may be adversely affected. Crossbreeding of Duroc with the "Torbiscal" strain improve carcass leanness, hams, forelegs and loins yield. The average daily gain during the finishing phase is not affected by Duroc crossbreeding (Dobao *et al.*, 1987). The acceptable productive features (average daily gain and feed conversion) and good carcass and meat quality characteristics of the "Torbiscal" strain makes this type of animals one of the most valorated genetic line for boars in Iberian productive systems, as an alternative of the Duroc breed.

The feeding of Iberian pigs during the fattening phase is the most important factor affecting carcass, meat and fat quality. Pigs finished outdoors in "montanera" and exclusively fed on acorns and grass, show significantly poorer average daily gain and carcass and hams, yields than animals fed on mixed diets (Daza *et al.*, 2006) (Table 2), but the fatty acid profile is most appropriate from a technological and commercial point of view (higher concentration of oleic acid and lower of palmitic, stearic and linoleic acids), and the muscle tocopherol content is higher (López Carrasco *et al.*, 2003; Rey *et al.*, 2006) (Table 3). The weight gained as a consequence of acorn and grass feeding, that is, the length of the outdoor rearing in "montanera", also influences the fatty acid profile of subcutaneous fat, and particularly that of oleic acid (Montero de Espinosa *et al.*, 1992), although more scientific knowledge is needed on this topic in order to increase the number of animals yearly fed outdoors in "montanera", allowing optimization of natural resources.

Table 2. Effect of feeding system on growth and carcass characteristics in Iberian pigs

Variable	N†	Feeding system	Value	Standard error
Average daily gain (g)	22	Free-range	501.48[a]	26.02
	21	Confinement	653.36[b]	11.12
Carcass weight (kg)	22	Free-range	121.31	1.76
	21	Confinement	119.79	1.79
Carcass yield (%)	22	Free-range	76.94[a]	0.23
	21	Confinement	77.97[b]	0.26
Hams weight (kg)	22	Free-range	21.52[a]	0.24
	21	Confinement	22.56[b]	0.25
Forelegs weight (kg)	22	Free-range	14.64	0.14
	21	Confinement	14.56	0.15
Hams and forelegs weight (kg)	22	Free-range	36.16	0.35
	21	Confinement	36.82	0.36
Hams†† (%)	22	Free-range	13.79[a]	0.16
	21	Confinement	14.32[b]	0.16
Forelegs†† (%)	22	Free-range	9.42	0.09
	21	Confinement	9.36	0.10
Hams + forelegs†† (%)	22	Free-range	23.25	0.22
	21	Confinement	23.64	0.22
Hams††† (%)	22	Free-range	17.93	0.21
	21	Confinement	18.37	0.19
Forelegs††† (%)	22	Free-range	12.23	0.12
	21	Confinement	12.02	0.12
Hams + forelegs††† (%)	22	Free-range	30.22	0.31
	21	Confinement	30.32	0.25

†N = number of pigs.
††Respect at slaughter weight.
†††Respect carcass weight.
[a,b]For each variable means with different superscripts are significantly different.

Table 3. Major fatty acids composition (%) of the subcutaneous backfat outer layer and α and γ tocopherols (µg/g) of *Longissimus dorsi* muscle according to the feeding system applied during the fattening period

Fatty acid	Feeding system					
	Free-range	Mixed diet†	Acorns†	Acorns and grass†	Root MSE	P
C16:0	19.10^{b}	20.47^{a}	19.16^{b}	19.34^{b}	0.946	0.0001
C18:0	8.74^{b}	9.96^{a}	9.00^{b}	9.45^{ba}	0.864	0.0001
C18:1 n-9	53.09^{a}	47.53^{c}	52.26^{a}	50.75^{b}	1.201	0.0001
C18:2 n-6	10.45^{cb}	12.66^{a}	10.11^{c}	11.43^{b}	1.261	0.0001
α-tocoph	2.21^{ab}	1.79^{b}	2.24^{a}	2.47^{a}	0.57	0.0001
γ-tocoph	0.73^{a}	nsd††^{b}	0.79^{b}	0.84^{a}	0.20	0.0001

†In confinement.
††nsd = not detected.
^{a,b,c}Values with different superscripts are significantly different (P < 0.05).

Evolution of productive systems: The need of continous control

As previously explained, around 85% of Iberian pigs slaughtered in Spain are finished in confinement and fed mixed diets. Three general orientations of feeding practices in the last 50 years can be differentiated into three groups: *traditional feeding, fake feeding* and *promising feeding*.

Traditional feeding was based in the use of mixed diets rich in carbohydrates (barley and wheat) and poor in fat, which leaded to a high consistency in pig fats, which as a consequence of feeding composition were rich in saturated fatty acids, showing melting points above 30°C. This latter criterion was used as a method for identifying the feeding background (either "montanera" or in confinement) after slaughter. Subsequently, since last decade of the 20th century, mixed diets were enriched in unsaturated fats in order to avoid endogenous synthesis and achieve lower melting points, similar (and even lower) to those of fat from pigs fed outdoors in "montanera" on acorns and grass (26-27°C). Feeding sources rich in linoleic acid were frequently used in feed formulation, such as corn, barley, wheat and soya bean. This feeding strategy, which is fake in its purpose, led to an increase in the susceptibility of the meat to lipid oxidation, to an enlargement in the ripening process of hams and forelegs and to a marked decrease in the sensory quality of meat products (López-Bote, 2001).

In recent years there is a trend to include ingredients rich in oleic acid in mixed diets for Iberian pig fattening (lard, oleines, high oleic sunflower oil, peanuts, rapeseed oil…), with the purpose of achieving an adequate fatty acid profile and a meat sensory quality similar to that of meat from pigs fed in "montanera". Furthermore, in order to substitute the antioxidant effect of tocopherols form acorns (γ-tocopherol) and grass (α-tocopherol) found in the meat of pigs fed outdoors in "montanera", mixed diets used for feeding Iberian pigs in confinement are supplemented with 100-200 mg/kg of vitamin E (α-tocopheryl acetate). In different experiments in which linoleic acid was replaced by oleic acid in the mixed diets without changing the saturated fatty and the linolenic acid contents, and feeding was supplemented with supranutritional levels of vitamin E, an increase in oleic acid and a decrease in linoleic acid in subcutaneous and intramuscular fat, together with a decrease in the susceptibility of meat to lipid oxidation (due to an increase in muscle and microsome α-tocopherol), a lower Σ(n-6)/Σ(n-3) fatty acids ratio, and an improve in some rheological properties of subcutaneous fat, such as consistency, elasticity, cohesiveness and adhesiveness (López-Bote *et al.*, 2002, 2003; Daza *et al.*, 2005b) was achieved. As expected, the influence of vitamin E supplementation in these experiments led to a reduction in the susceptibility of pig tissues to lipid oxidation. It has been also observed an interaction between the level of vitamin E in the feeding and the ratio oleic/linoleic acid, so that the lower the vitamin E inclusion in the feeding and the lower the monounsaturated fatty acids/polyunsaturated fatty acids (MUFA/PUFA) ratio, the lower the muscle microsomes α-tocopherol concentration, leading to an increase in the prone of the meat to get oxidized (López-Bote *et al.*, 2003). An example of the influence of dietary partial replacement of poly-with monounsaturated fat on fatty acid profile of subcutaneous backfat is presented in Table 4.

Table 4. Fatty acid composition (g/100 fatty acids) of the subcutaneous fat (outer and inner layers) from Iberian x Duroc pigs finished in confinement with formulated diets

Fatty acid	Dietary fat†			Pooled SEM
	Mono	Medium	Poly	
Outer layer				
C16:0	22.31	23.75	23.40	1.78
C18:0	13.71	14.59	14.18	1.16
C18:1 n-9	44.40[a]	41.58[b]	41.41[b]	2.27
C18:2 n-6	8.83[a]	9.07[a]	10.59[b]	0.88
Σ SFA††	37.62	40.09	39.29	2.66
Σ MUFA††	52.55[a]	49.51[b]	49.02[b]	2.49
Σ PUFA††	10.63[a]	11.47[ab]	12.51[b]	1.03
Inner layer				
C16:0	25.53	26.16	25.51	1.30
C18:0	15.59[a]	17.60[b]	17.52[b]	1.30
C18:1 n-9	41.70[a]	39.16[b]	39.14[b]	1.68
C18:2 n-6	7.81[a]	8.09[a]	9.19[b]	0.58
Σ SFA††	42.78	45.45	44.67	2.10
Σ MUFA††	48.06[a]	45.06[b]	44.69[b]	1.81
Σ PUFA††	9.19[a]	9.52[a]	10.64[b]	0.66

†Mono, medium and poly diets contained a 4% of added fat. The mixed diets contained the same concentration of saturated and linolenic fatty acids. Mono: 1.54% Iberian pig lard + 2.64% olive oil oleine (21 g of C18:1 n-9/100 g fatty acid); Medium: 1.87% Iberian pig lard + 0.9% sunflower oil oleine + 1.23% olive oil oleine (16 g of C18:1 n-9/100 g fatty acid); Poly: 2.20% Iberian pig lard + 1.80% sunflower oil oleine (14 g of C18:1 n-9/100 g fatty acid).
††Σ SFA, Σ MUFA, Σ PUFA = sum all saturate (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids, respectively.
[a,b]Within row, means with different superscripts are significantly different $P < 0.05$.
Source: Daza *et al.* (2005b).

Supplementation of feeding with copper may decrease the proportion of saturated fatty acids and increase that of MUFA. In fact, supplementation with only 35 mg of copper per kg of feed was enough to modify the fatty acid profile of hepatic tissue from Iberian pigs fed in confinement with mixed diets. The concentration of lauric (C14:0), palmitic (C16:0) and margaric (C17:0) acids in neutral lipids decreased and that of oleic acid and unsaturation index increased, although the latter two effects were not significant (López-Bote and Rey, 2001).

These feeding strategies are promising for the Iberian pig sector as a whole, since are aimed not only to improve the profitability of farmers, but also the technological quality (industrials) and the sensory, nutritional and health features of the product (consumers).

The use of biological (both animal and vegetal), labor, technical and financial resources have experienced notable changes in the last 50 years. The traditional free range system for rearing Iberian pigs, which has nowadays almost disappeared, was characterized by:

(i) The use of pure Iberian breed.

(ii) Reproductive plans involve farrowing during May-June and November-December for adult sows, and during February-March for gilts born in November-December. Non-pregnant sows mated in summer, and that consequently will not deliver in November-December, will mate again during autumn, together with the gilts. Those sows delivering in February-March will mate again in May-June.

(iii) Weaning of piglets at 8-9 weeks of age.

(iv) Feeding of reproductive animals based in the available sources of the "Dehesa" and supplemented with mixed diets during the last month of pregnancy and lactation. According to Benito *et al.* (1986), the free range feeding of Iberian sows in the "Dehesa" allows in saving close to 30% of energetic needs for gestation and 20% for lactation.

(v) Birth in open pens, which led to a high rate of mortality in piglets due to crushing.

(vi) Free rearing of pigs during the "recria" and "recebo" phases, in farmyards with feeding supplementation (1.5-2.5 kg/day) and finishing in "montanera", with an animal density of 0.6-0.7 pigs/ha. Also "recria" and "recebo" phases in montanera and finishing with mixed diets.

In recent years, the Iberian pig meat industry has developed considerably, with the incorporation of modern production and processing techniques. Modern technologies of feeding and management are now commonplaces, in some cases combined with traditional practices. Of course quality characteristics of meat products are not comparable to those obtained from pigs raised extensively, probably due to the effect of feeding, exercise, temperature, etc., but they are still meat products of high quality. Quality control measures have been implemented to avoid fraud in the marketing. At the moment the main struggle in this sector is to preserve the quality attributes of the traditional systems and establish controls that avoid fakes practices, thus allowing the farmers that produce according to the traditional way to obtain a higher income for their pigs than those using alternative production systems (other breeds, production in confinement, etc.).

At the moment, the Official Quality Norm establishes (despite the reluctance of some important members of the Iberian swine industry, such as dry cured ham processors) that the sows should be pure Iberian breed, allowing the boar to be either pure Duroc or crossbreed Duroc x Iberian. Nevertheless, some farmers claim that prohibiting the use of pure Duroc or Duroc x Iberian sows could be an economical drawback for Iberian pig farms, due to a significant decrease in productive traits.

The traditional production of meat products from Iberian pigs has very little in common with that of meat products obtained from selected pigs raised under intensive conditions, and it constitutes an example of the preparation of high quality meat products, comparable to the most exquisite food products in the world. The production of Iberian pig is deeply bound to the Mediterranean ecosystem. It is a rare example in the world swine production where the pig contributes so decisively to the preservation of the ecosystem.

The future of Iberian swine sector is promising. The extraordinarily social prestige of Iberian meat products, the progressive increase of consumers income (which stimulates consume of highly rated products), the notable effort carried out in the organisation of the productive sector and in the homogenization, typifying, traceability and hygienic trustfulness of the derived meat products, and the exportation to countries of the European Union, and to America and Japan, could be exponents of such future. This has to be based in strict quality control of the entire process of production, processing and commercialization.

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