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The production system of high quality pork products – an example

MAGDALENA SZYNDLER-NĘDZA[1], JACEK NOWICKI[2], MARTYNA MAŁOPOLSKA[1]
[1] Department of Pig Breeding, National Research Institute of Animal Production
[2] Faculty of Animal Breeding and Biology, University of Agriculture in Krakow

Abstract: *The production system of high quality pork products – an example.* The aim of the article was to present the Spanish production model of dried, ripening hams – Jamon Ibérico. Many years of Spaniards' experience in extensively fattened Iberian pigs, using the potential of pastureland areas called dehesa and refining the technology of ham production in a slow drying process makes the obtained product (Jamon Ibérico) characterized by very good quality (confirmed by scientific research) and palatability. The established law regulations of this kind of production in royal decrees issued in 2007 and then in 2014 introduced a number of regulations to improve and stabilize the quality of the final product. Because of the care for the safety of genetic resources of Iberian pigs, regulations on the origin of animals, their treatment and breeding methods have been tightened. In addition, the labeling conditions for regional products have been defined. The aim of these new labeling conditions is to ensure the possibility of identifying the breeding system and the way of feeding Iberian pigs by placing appropriate markings on the labels of finished products. The above mentioned actions are an example of the Spanish concern for the interests of both consumers and producers of Iberian pork products. With the dynamically operating promotion system, dried ham Jamon Ibérico is known not only in Spain but throughout the whole Europe.

Key words: Ibérico pigs, fattening, regional product, law regulations

INTRODUCTION

In recent years, an intensive growth of pig population has been observed in Spain. According to Eurostat (2017) from 2014 to 2017 pig population increased more than 3 million head, reaching nearly 30 million head. During that time, the number of slaughtered pigs also increased and exceeded 50 million heads in 2017 (Fig. 1).

In Spain, pig production is conducted in two directions. The first one is focused on intensive fattening of highly productive breeds and/or lines based on the latest technologies. It is also the main reason of increasing professionalisation, export and production in this country. The second direction is extensive production with use of the native Ibérico breed, in order to obtain a high-quality product – Iberian ham (Jamón Ibérico). Although, only 11% consists extensive production in Spanish pig production, the final product is worldwide known and appreciated. The products from native Ibérico breed are good example of close cooperation with scientists, producers and public institutions. Ibérico is the common name of several native pig breeds in Spain.

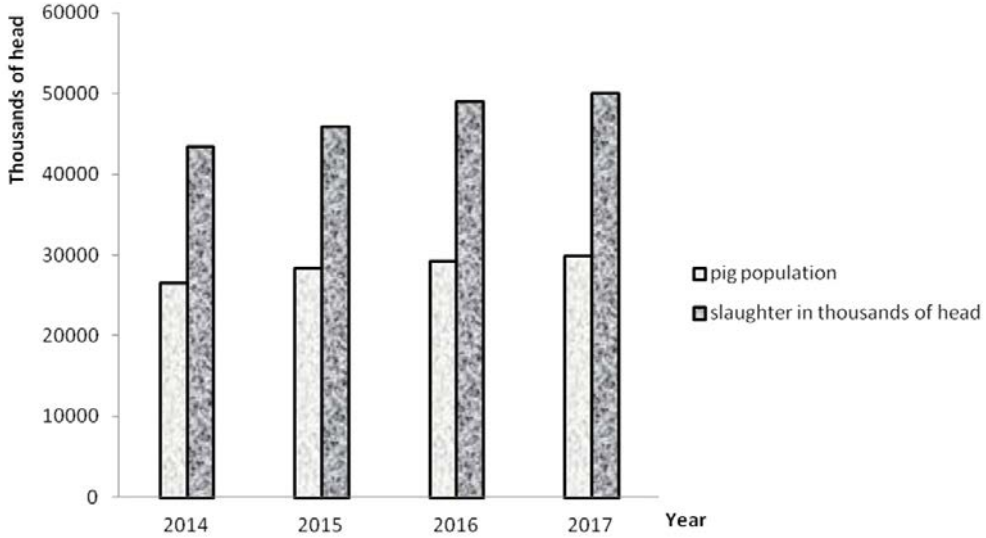

FIGURE 1. Pig population and number of pigs slaughtered in Spain in 2014–2017
Source: Eurostat data (2017).

According to FAO (http://dad.fao.org/ – for 2016) the largest number of animals were kept in the Ibérico breed (Iberian black) – 560 591 animals, and then in varieties of Ibérico: Retinto (red) – 287735 animals, Entrepelado (red and black) – 38 428 pigs, Torbiscal (red) – 4619 pigs, Negro Lampiño (black with spots around a snout) – 3461 pigs, Manchada de Jabugo (spotted) – 123. In 1997, two additional breeds were bred: Dorado Gaditano and Mamellado, but at present its number is unknown. The supervision of breeding herds and certification of animals is carried out by the Spanish Association of Iberian Pig Breeders (*Asociación Española de Criadores de Cerdo Ibérico* – AECERIBER). Ibérico pigs (Fig. 2) have primitive type, are characterized by relatively small size with long snout and legs. The withers high usually reached 90 cm in boars, with body weight to 140 kg, while sows 75 cm – withers high and 120 kg body weight. Moreover, their growth is slow, from 360 g/day (Ibérico) to 700 g/day (Torbiscal). Those traditional Spanish breeds, are raised free-range in the dehesa – mountains area with the oak forests and grasslands. The area of oak forest occurs only in the south of the Iberian Penisula, in 0.7 million hectares in Portugal and around 2.3 million hectares in Spain (System report...). Most of these areas occur in Andalusia (approximately 1.2 million hectares) in the provinces of Córdoba, Huelva, Seville, Jaén, Cádiz, Granada, Malaga and Almería (Dehesas...). The dehesa is a grassland featuring in herbaceous plants and from the heath family and species in the genus Quercus (oak). Depending of the region the different oak trees occur: evergreen oak trees (Quercus ilex), cork oaks (Quercus suber) or yellow oaks (Quercus lusitanica) (Lopez-Bote 1998) (Fig. 3).

FIGURE 2. Ibérico fatteners
Source: photo by M. Szyndler-Nędza

FIGURE 3. Oak acorn
Source: photo by J. Nowicki

In dehesa may also occur trees such as: beech, pine and chestnuts. This unique ecosystem was created by removing Mediterranean forests and planting oaks. Oak trees were planted in an orderly manner to maximize productivity by balancing the amount of light for grass and water in the soil. Dehesa is the habitat of protected animals such as eagle, lynx, for many birds (60 species), over 20 species of mammals and many reptiles and amphibians. Although, it is primarily use for grazing cattle, sheep and goats and to produce acorns for pigs. Iberian pigs are fed on acorns and grass from end of October (the maturation of oak acorns) until January (Olea and San Miguel-Ayanz 2016). To reduce damages (caused by rooting) to the tree layer and forest undergrowth, pigs have nose rings (Fig. 4).

FIGURE 4. Ibérico pig with nose ring
Source: photo by M. Szyndler-Nędza

The final stage, where pigs are feed on acorns and pasture have the greatest impact on quality and taste of meat, which have been confirmed by numerous studies (Fernàndez et al. 2007, Gandemer 2009, Pugliese and Sirtori 2012).

FACTORS AFFECTING THE QUALITY OF MEAT AND ITS PRODUCTS

IMF and bred

The organoleptic properties of raw meat are mainly associated with intramuscular fat (IMF). The minimum acceptable fat level should range between 2.0 and 2.5% (Affentranger et al. 1996). IMF affects the quality traits of raw-ripened ham such as: color, brightness and shear force. These features decrease with the increases of IMF. Moreover, IMF level prevents water losses during meat processing (cooking, grilling etc.) (Tyra et al. 2013) and plays important role in the sensory evaluation. Due to the presence of intramuscular triacylglycerols, which are a good solvent for most aromatic compounds, the ham (made from raw meat with high IMF) is characterized by an intense fat aroma (Gandemer 2002, 2009). The content of IMF depends on bred, sex and varies with pig' growth. Fernàndez et al. (2007) showed vide range of IMF in longissimus muscles from 3.27 to 29.21% in Ibérico pigs.

Native breeds have a great predisposition to the deposition of one unsaturated fatty acid from the MUFA group (oleic acid) in comparison to selected/ /improved breeds, which have higher amount of saturated fatty acids (SFA) (Pugliese and Sirtori 2012). The high level of unsaturated fatty acid in local breeds may be a consequence of different lipids synthesis and may also affect the length of fattening. Additionally, the ability to deposit unsaturated fatty acids increase with age (Edwards 2005). However, those differences can be overcome by mating pure-breed Ibérico with Duroc pigs (Carrapiso et al. 2003). In Spain, crossing native sows with Duroc boars is commonly used to improve the production parameters of offspring without affecting their resistance and IMF. Both traits are important for processing sector, for example level of marbling is a recognized criterion for the quality of dry hams (Edwards 2005).

Fattening stage

The numerous studies showed that quality of pork is affected by duration of fattening period but not by housing system (Pugliese and Sirtori 2012). Jonsall et al. (2001) and Lopez-Bote et al. (2008) did

not found differences between pigs of the same age, housed in different systems: free range and indoor, in tenderness of meat, while minor differences in juiciness and color were found. The research results suggested that activity on pasture is not sufficient to impact meat quality features. Meat from fatteners (slaughter at 88 kg, 487 days), housed free range is characterized by darker color and higher shear force in comparison to raw meat obtained from fatteners (100 kg, 448 days) housed indoor (Pugliese et al. 2004). The color of meat is related to the myoglobin concentration in the muscles, which increases with animals' age (Mayoral et al (1999). According to Janicki and Buzała (2013) hardness and tenderness of meat is influenced by content of collagen in the muscles, while breed, feeding, muscles activity, age at laughter and time of maturation and castration affected the content of collagen.

Feeding

The production of Iberian pigs is deeply bound to the grasslands and forests. Thus, the animals are grazed on acorns and pasture which is one of the main differences between commercial feed. As was mentioned above, fat composition is related to genotype and type of feeding system as well (Gandemer 2002). It has been shown, that fatty acid profile in Iberian pigs' ham and bacon have higher level of unsaturated fatty acids, especially MUFA (oleic acid) and lower SFA (palmitic and stearic acids) than ham obtained from commercial breed (reared inside) (Andrés et al. 2001, Cava et al. 2000, Dìaz et al. 1996). Moreover, pigs' diet based on pasture and enriched with chestnuts increase the PUFA level in fat (Pugliese et al. 2005). It is due the fact, that chestnuts have higher concentrations of polyunsatured fatty acids than acorns (Lopez-Bote 1998). Nutrition also affects the fatty acid profile in ripened products, especially when pigs are reared outdoor on pasture or forest, with access to acorns and grass (Pérez-Palacios et al. 2010).

Green fodder and acorns are good source of vitamin E (α-i γ-tocopherol) which is known of its anti-oxidant properties. In pigs, vitamin E is accumulated primarily in fat and then in meat. Rey et al. (2006) confirmed the increased of γ-tocopherol in the tenderloin and bacon obtained from pigs reared in extensively system, in comparison to pork obtained from animals reared indoor and feed with commercial feed.

PRODUCTION SYSTEM

Breeding

The breeding of Iberian pigs' has a long tradition, as well as a many years of experience handed from one generation to the next. Thus, the quality and unique taste of the products are results of knowledge, hard work and proper breeding management.

Ibérico sows have from 6 to 10 piglets per litter, and two litters per year. Piglets are separated from their mothers when they are 43 days of age. Ibérico sows are mostly mated with Duroc boars or Ibérico × Duroc boars to obtain better fattening parameters from offspring. However, the best quality products are obtained from pure Ibérico fatteners but they are characterized by the highest price. Piglets of both sexes are castrated in young age, to avoid unplanned pregnancy in females (during fattening period in dehesa), and

boar taint in meat. The fattening period in the dehesa starts in parallel with production of acorns, usually from October until December. During this time, average daily gains are small so the first stage of fattening period is slow and should be finished at (minimum) 12 month of age and 90 kg body weight. Additionally, pigs have access to both pasture and shelter, where they are fed 2 kg of feed per day. The feed consists: cereals (wheat, barley) and field peas (Fig. 5). Then, pigs are released on dehesa and fed with acorns (Bellota system) – this is the last stage of fattening. Due to the fact, that one pig can eat ten kilograms of acorns a day, the required space for one pig is 1 hectare of dehesa. Crossbreed pigs (50% Ibérico) are released onto the dehesa at the age 12 months and 115 kg of body weight, while pure breed pigs (100% Ibérico) at age 14–15 months and 90–100 kg. The fattening period ends when pigs reach a body weigth over 150 kg (approximately 60 day at dehesa for crossbreed fatteners, and 6 months for pure Ibérico pigs). It is worth to mention, only 5% of pure breed fatteners are kept so long in the dehesa. Slaughter is carried out in slaughterhouses in accordance to regulation and care of stress-free slaughter to obtain better quality products.

Fatteners which could not be kept in the pasture (dehesa), are reared outdoor in fenced area with access to feed with cereals and legumes (de Cebo de campo system, mainly for crossbreed pigs) or indoor with access to fenced pasture (de Cebo system, only for crossbreed pigs).

Processing

Typical Spanish products are produced in a slow, natural drying and curing processes. The first stage of production is multi-day maturing of meat at 4°C, then hams are covered with salt, which is replaced every week. After three weeks, the hams are rinsed in water to remove salt from the surface. The next stage is drying in increasing temperature (controlled through ventilation) for about 2 weeks, which causes "sweating" (dissemination of fat through the muscle fibers) – (www.jamon.com). According

FIGURE 5. Feed for Ibérico pigs
Source: photo by M. Szyndler-Nędza

FIGURE 6. Maturation of ham
Source: photo by M. Szyndler-Nędza

FIGURE 7. Final product – Ibérico ham and bacon
Source: photo by M. Szyndler-Nędza

to Andrés et al. (2004) increase in temperature during the drying phase reduced rancidity in the products. The last stage of production is maturing and drying at a constant temperature for a minimum of 2 years up to 4 years (Fig. 6). Thus, the entire production cycle from piglet to a final, highest quality product in which the aroma of the acorn is perceptible lasts a maximum of 6 years (Fig. 7).

THE RELATIONSHIP OF BEHAVIOUR, WELFARE AND MEAT QUALITY WITH PROMOTION OF PORK FROM PIGS FATTENED OUTDOORS

It is estimated, that over half of commercial world pig farming is highly intensive. The rearing and fattening pigs take place mainly indoors and is also known as industrial pig production or "factory" farming. Pigs in most countries are kept in barren pens at high stocking densities (Compassion in World Farming). Some alternative solutions to intensive farming systems have been developed to overcome welfare concerns associated with "factory farming". Most of them are based on traditional farming systems, that were commonly used before industrialisation, which took place in the 1950s. Some farms use modern technology to achieve better welfare (Compassion in World Farming), but in fact only outdoor systems for pigs provide full expression of natural behaviour comparable to the behaviour of the wild boar (Stolba and Wood-Gush 1989).

Outdoor pig production offers animals increased environmental diversity and behavioural freedom but imposes challenges for breed adaptation, management control, biosecurity (what is especially

important nowadays in case of ASF), and environmental protection. Each of these issues has potential implications for the real as well as perceived quality of the product (Edwards 2005). Especially the shaping proper consumer perception is the chance for farmers to develop outdoor housing and make it profitable.

In most conventional Northern European production systems, only adult and suckling animals are at pasture. However, in traditional Mediterranean systems (like in Spain) and in organic production systems, meat animals may be maintained outdoors throughout their lives (Edwards 2005). Not only Spain is a centre of outdoor pig production. As shown by Edwards (2005), outdoor pig production systems come in many forms. In some European countries, particularly UK and France, there are significant numbers of outdoor herds contributing to conventional pig meat supplies. In the UK, it has been estimated that approximately 30% of the national sow breeding herds are housed outdoors.

The major difference between pigs produced outdoors and indoors is the exposure to plentiful fresh air and greater extremes of climate. Such circumstances may influence both primary and secondary product quality attributes (Edwards 2005). The outdoor environment clearly has potential for both positive and negative effects on pig health and welfare (Edwards and Zanella 1996). As shown by Olczak et al. (2015) weather conditions (temperature, humidity, solar radiation, air pressure, wind strength, wind direction and precipitation) have a significant impact on the behaviour of farm animals. Pigs have developed a wide range of thermoregulatory behaviours that are particular for this species. Together with the increasing temperature, the activity decreases but the wallowing in wet surfaces increases highly. In addition to this, rooting and wallowing are highly affected by temperature and humidity. The most important is that outdoor enables the expression of above mentioned behaviours, at all. The lack of possibility to express these behaviours in most of the indoor housings leads to development of stereotypies and tail and ear biting (Nowicki et al. 2015). Interestingly, low temperatures do not increase the use of shelter, if not in combination with wind or precipitation (Olczak et al. 2015). Furthermore, wild pigs build stronger nests in severe conditions. Also, resting behaviour and reproduction may be disturbed by high temperature (Olczak et al. 2015) which is typical in Spain.

Studies on the relationship between housing system for pigs and meat quality characteristics were carried out, but their results are not homogenous (EFSA 2005). Enfalt et al. (1993) observed greater leakage of water and the lighter colour of meat of more active pigs (the daily activity in outdoor is about 70–80% of time, while in indoor only 20% (Stolba and Wood-Gush 1989). In contrast, in studies of Gentry et al. (2002) pigs housed in open outdoor system had better quality characteristics of meat: meat was darker and redder, and more fragile. There are still no clear data about daily behavioural profile of pigs housed outdoors and its effects on meat quality. Nowicki et al. (2014) found no statistical differences in physico-chemical parameters of loin from fatteners housed indoors and in outside run enclosures,

but better sensory quality of cooked meat originated from fatteners housed on the enclosures was found by the 6 person team with a proven pre-sensory sensitivity. Similar results were obtained by other authors as showed in Edwards review (2005). According to this paper (2005) the majority of studies reported no difference in juiciness or tenderness. Some of the studies reported reduced juiciness in outdoor. A significant number, however, have reported reduced muscle pH and/or increased drip loss, suggesting greater susceptibility of outdoor pigs to pre-slaughter stress, probably because the animals are not used to be kept in small areas which are common during transport and in the abattoir.

On the other hand, the outdoor housing has positive influence on the animal welfare especially due to the wide range of environmental enrichment on the pasture (Edwards 2005) and possibility of free movement (Stolba and Wood-Gush 1989). There is no doubt that in the environment poor in stimuli, strongly motivated propensity to foraging and exploration is directed to the other pigs in the pen (Lyons et al. 1995, Kelly at al. 2000) and its equipment (Lyons et al. 1995). This can lead to aggression and cannibalism (Beattie et al. 1995). In such conditions, abnormal behaviours happen more often (van de Weerd et al. 2005, Scott et al. 2006). The reduction of the frequency of agonistic behaviour in the enriched environment, reflects the lesser need to reciprocate persistent provocations from other pigs (Beattie et al. 1995, Nowicki and Klocek 2012, Nowicki et al. 2015).

As shown in the Edwards (2005) review, since early enrichment has been shown to modify the physiological response to stressors, and since stress physiology can have a very significant effect on meat quality (as either PSE or DFD muscle depending on the nature and duration of stress response), enrichment has the potential to exert a major influence on final product quality (Warriss 1994). However, research results have been equivocal. It has been suggested that pigs from more enriched environments are less stress susceptible and might therefore deal more adequately with transport and pre-slaughter handling. Barton-Gade and Blaabjerg (1989) observed that pigs reared outdoors were calmer and more easily handled at the abattoir than intensively-reared pigs, although muscle pH values were lower for these pigs. In another study, outdoor pigs showed a decrease in ultimate pH and in water retention capacity, suggesting that these pigs experienced greater pre-slaughter stress (Gandemer et al. 1990). Similarly, in more controlled experiments, environmental enrichment has sometimes resulted in reduced pig meat tenderness (Beattie et al. 1993),

As shown by Nowicki et al. (2014) members of the taste panels when aware of the origin, rated free range pork as more valuable than meat from indoor pigs. Consumers' perceptions of a production system are therefore highly likely influences their perception of the quality of product produced from outdoor system (Edwards 2005). This phenomenon is especially highly relevant to marketing of pork from outdoor systems because, consumers perceive outdoor systems to be more humane, environmental friendly, traditional and sustainable (Edwards 2005).

In the Mediterranean systems, outdoor pigs are important for management of the forest heritage. The dehesa is a man-made ecosystem and, when abandoned, it rapidly becomes unproductive, due either to shrub growth, which limits the grazing and provokes risk of fire, or to disappearance of trees and desertification. Pig production in silvopastoral systems, even if the pasturage of animals is limited to the finishing period, is therefore of major significance in the conservation of landscape in Mediterranean areas (Edwards 2005). So the environmental protection, important for modern consumers is ensured. Finally, consumers often perceive that meat produced in outdoor systems is more nutritious and safer, with lower use of feed additives and antibiotics (Edwards 2005).

The next important issue is the conviction of consumers that animals are able to express the natural behaviours. Public opinion is more and more interested in animal welfare and even in animal rights. Foraging is the basic behaviour in wild boar and this behaviour did not disappear in domestic pigs. Natural selection favoured those wild boars who foraged and rooted most and the behaviour is now fixed, or hard-wired, also in the modern, domestic pig. This means that all pigs are still highly-motivated to explore their surroundings and forage for food (Beattie and O'Connell 2002, Studnitz et al. 2007). It is the reason why only outdoor housing can fulfil behavioural requirements of pigs. The forage feeding may indeed increase some health promoting aspects of pig meat (Nilzen et al. 2001, Hogberg et al. 2002). This type of feeding is especially used in Spain on the dehesa pastures where pigs during autumn and winter are able to look for and eat acorns and herbs. Chemotherapeutic medication use is also lower in outdoor herds, and they are not permitted as standard treatments in organic production systems. However, the reduced control of biosecurity in outdoor systems, and the threat of zoonotic infection from wildlife, may mean that microbiological quality of the carcass is actually poorer in some instance (Edwards 2005).

Outdoor housing of original Polish breeds of pigs together with the promotion of meat originated from these system and shaping the perception of consumers through the marketing procedures may be the way to develop smaller farms, producing high quality meat. It seems to be possible when the argumentation presented above is used. But one important factor is necessary – strict cooperation of farmers, marketing specialists and scientists to achieve this goal. The good example is just Spain where not only tradition guarantees the success of dried hams (Jamon Ibérico) and other pork products, but the consumers' conviction about animal friendly and environmental friendly farming systems is crucial.

LAW REGULATIONS

As a consequence of the above production, dried Iberian ham is classified in several quality categories according to the conditions of breeding and rearing animals. Originally these categories were included in Royal Decree 1469/2007 (BOE-A-2007-19073) approving the quality standards of Iberian pork, ham, shoulders and pork loin. This document drew attention to the fact that it should be possible to compile existing texts on

the processes of producing these regional products of pork origin. At the same time, the scope of its application has been extended to the products derived from the cutting of carcasses, sold as fresh meat. The introduction of uniform regulations, especially in the area of labelling, was an example of concern for the interest of consumers and producers of Iberian pork products (including Jamon Ibérico). The introduction of strict legal regulations was also necessary due to the need to protect and maintain forest pastures at an appropriate level, which are closely related to pig production. According to the decree, this production should be carried out in a sustainable way and not endanger the extremely delicate pasture ecosystems (dehesa). As a result of the provisions of this regulation, the control mechanisms were strengthened by strengthening the provisions on the so-called Independent Control Units. A special office has also been set up to monitor, harmonize and develop everything related to the quality standard of Iberian pork products. In 2014, however, a new royal decree 4/2014 (BOE-A-2014-318) was published. It currently approves the quality standards for meat, ham, shoulder ham and pork loin produced in Spain.

The necessity of issuing a new regulation was related to the fact that some imperfections in the production process were visible, such as regress in keeping Ibérico pigs breed pure after several years of functioning of quality standards based on previous regulations. What is even more important, the difficulties associated with the acceptance and familiarity of products by consumers as a result of excessive diversity of labels and descriptions on labels that could lead to confusion for the consumer were also detected. It was found that the use of many product labels was inappropriate and misled consumers. The consumer was not able to distinguish pork products of different categories effectively. It was therefore concluded that this type of unfair competition between producers should be stopped. It was also proved that there were cases of unauthorized use of trademarks, logos, images, symbols and descriptions that referred to aspects related to products whose trade name did not correspond to their actual origin and quality. This caused huge confusion among consumers who believed that they were purchasing a product associated with dehesa, meanwhile, in fact, they were buying a product from an animal that was never in the ecosystem. An interesting fact is that between 2005–2008, the Spaniards supported their production of dried hams by importing meat (ham) from Polish domestic breed pigs. An authorized person from the Spanish side chose heavy fatteners (minimum 150 kg) of Puławska and Złotnicka Spotted pigs, which were slaughtered and their elements (hams) were exported to Spain. The export took place through the Constar Starachowice (nowadays Animex).

In the new Royal Decree (BOE-A-2014-318; 2014) all deficiencies related to the 2007 legislation were improved. The quality standards are nowadays strictly attributed to the labelling conditions that aim to facilitate the differentiation of Iberian pork labels. Current legislation also takes into account the general requirements for labelling and provision of food information in the EU. It was also found that there is a need to improve the racial purity of animals placed on the

market according to the quality standard, because the use of non-registered sires in the 'Iberian Swine Race' in crossbreeds with other breeds can be dangerous to the genetic resources represented by the Iberian race. Regarding the production models, the need to change the farming and animal nutrition conditions in each of them was noted, as well as the need to reduce the acceptable stocking density in the dehesa system in order to avoid possible deterioration of the ecosystem quality. For acorn-fed animals, the newly introduced legislation is expected to reinforce control at the stage of using the pasture by individual identification of each animal. Controls of forest areas are also necessary to ensure that animal nutrition is based on the use of acorns and is a factor guaranteeing the improvement of the dehesa ecosystem. In case of the animals fed on feed, it was considered necessary to lay down implementing rules. These provisions should apply to both the treatment of animals and farming methods, all aimed at improving the quality of products.

Another novelty in comparison to the previous regulations is law focused on the improvement of the traceability of products by the requirement of placing seals on products that must enable identification of the breeding system and the way of feeding pigs.

In addition, stricter and clearer requirements were set for product labelling to improve the quality of information received by consumers. It was considered important to inform the consumer about the percentage share of the Iberian pig from which the purchased product comes from. In addition, restrictions have been imposed on the use of certain descriptions, logos, images, drawings, acronyms, brands or emblems on labels that may mislead the consumer in relation to the product purchased, in particular to avoid confusion between products in which the raw material is based on pigs housed on the pastures, and swine foodstuffs derived from pigs fed with compound feed.

In this legal act from 2014, a number of concepts related to pig production as well as the processing and preservation of high-quality pork products have been strictly defined. The most important definitions include:

– Dehesa – in other words, meadow, pasture, or geographical area in which agro-forestry and land-use techniques are used, based mainly on the presence of animals on the grassland and forests, where mainly oaks occur. In this area, human activity is necessary to ensure protection and durability of these oaks. The presence of at least 10 trees in the area of 1 hectare is required.
– "Montanera" – is an animal diet based on the use of acorns and grazing resources of dehesa in Spain and Portugal.

Designation by type of the product:

- Designation by type of the product:
  - In the case of processed products, these are: ham, shoulder, pork or "emborrado pork" or sirloin.
  - In the case of products obtained from cutting a fresh carcass, the markings of meat elements (cuts) originating from cutting shall be used in accordance with accepted market names.
- Descriptive indications depending on the diet of pigs

– "De Bellota", or "acorn": in relation to products from animals slaughtered immediately after finishing the fattening period, based on acorns, grass and other natural resources of the meadow, without the use of additional nutrition.

In case of products marked as "Bellota", the annex to the mentioned decree (2014), the stocking density of animals staying on dehesa according to the percentage of the area covered by trees should be as presented in the Table 1.

On the other hand, in the case of products originating from animals whose feeding and proceedings to achieve the slaughtering weight, does not include the above mentioned point, the following descriptive markings are used:

– De Cebo de Campo – in free translation, nutrition in the field – used in the case of products from animals that during fattening in the pasture used the resources of this pasture, but were also fed with feed consisting mainly of cereals and legumes.
– De Cebo – in the case of animals fed with feed, consisting mainly of cereals and legumes, which are kept in intensive systems (with a small range).

• Designations according to the breed or crossing pattern
  – 100% Ibérico – 100% Iberian breed – in the case of products derived from animals of 100% genetic purity of the Iberian race, whose parents also represent 100% racial purity and are registered in the appropriate breeding book.
  – Ibérico – in the case of animal products with at least 50% of the Ibérico bred, whose parents fulfil the following conditions:
    • For products labelled "75% Ibérico" from animals with 75% Ibérico, mothers must be pure-bred Ibérico sows, registered in the studbook, while fathers must come from the crossbreed of the Ibérico pure-bred sire and Duroc's pure-bred father.
    • For products designated "50% Ibérico" from animals, Ibérico pure-bred sows are used, while fathers represent pure Duroc breed. Both must be registered in the appropriate genealogy lineage of the breed.

Determining the origin of parents is carried out using the so-called "racial

TABLE 1. The stocking density of animals staying on "La dehesa" according to the percentage of the area covered by trees

Percentage share of the area covered with trees	Maximum allowable stocking density (animals/ha)
to 10	0.25
to 15	0.42
to 20	0.58
to 25	0.75
to 30	0.92
to 35	1.08
Larger than 35	1.25

certificates", issued by an appropriate officially recognized association to manage the so-called book of origin. Verification of the breeding factor of animals intended for slaughter to obtain Iberian products is carried out by a control body accredited by a Spanish national accreditation organization. In the label of pig product it is mandatory to give the percentages of Iberian pigs.

Labelling

Product labels, in accordance with the decree, must comply with the general applicable provisions on the labelling of food products. It is forbidden to use the trade name which is incomplete, adding to it terms other than the conditions specified in art. 3 of the Decree (2014). According to these regulations (BOE-A-2014-318; 2014) signs forming the trade name must be in a visible place and in each case, in the same field of view as the trade brand, in the same font size of the same size, thickness and colour.

In addition to the trade name, the products included in the discussed standard with the exception of fresh meat, must acquire the following mandatory information on the label:

In the case of products originating from crossbreds, the percentage of the Iberian animal from which the product originates is indicated by the expression "% Iberian breed". This indication must appear very close to the product name, using a font size of at least 75% of the product name and not less than the minimum size required in Article 13, paragraph. 2 of Regulation (EU) No 1169/2011. The label must also include the term "certified by" followed by the name of the independent control body or its acronym. This expression should be placed on the label next to the trade name. Currently, contrary to the regulation of the previous decree of 2007 (Royal Decree 1469/2007; BOE-A-2007-19073), the use of the terms "Recebo" (fed with acorns and fed with compound feed) and "Ibérico puro" (pure Iberian) is also prohibited.

Products labelled "De bellota" must come from animals whose fattening is based on specific conditions, including: the introduction of animals into pastures and should take place between October 1 and December 15, which means the period of slaughter between December 15 and March 31.

The most important minimum conditions that animals must meet primarily relate to the body weight, which at the beginning of the fattening phase with the use of acorns must be ranged between 92 and 115 kg, with the minimum slaughter age – 14 months.

For consumers, however, the most important is the ability to easily identify product categories. Therefore, in contrast to the decree of 2007 (Royal Decree 1469/2007; BOE-A-2007-19073), the latest legislation Royal Decree 2014 (BOE-A-2014-318; 2014) introduces the colourful labels, where each colour is assigned to an appropriate category of hams depending on the way pigs are raised. The following colours are used:

- Black – means feeding pigs during the period of being on dehesa only with acorns, the breed of pigs is 100% Ibérico (De Bellota, 100% Ibérico).
- Red – means feeding with acorns, pigs are crossbreds with the Ibérico breed (De bellota, Ibérico)
- Green – means feeding with commercial feed mixtures, however, animals

can use its resources in the pasture, the pigs are crossbreds with the Ibérico breed (De Cebo de Campo, Ibérico).
– White – colour means animals fed with commercial feed mixtures, which are kept in buildings with access to small runs, pigs are crossbreds with the Ibérico breed (De Cebo, Ibérico).

Due to the fact that the process of ham ripening lasts for several years, transitional periods have been planned, according to which the processor holding products in development after the entry into force of this standard, but whose marketing is planned after March 1, 2014, while stocks last, may label products in accordance with the provisions of royal decree 1469/2007, or move to labelling them with new trade names in accordance with the 2014 standard.

SUMMARY

Years of experience in the extensive Iberian pig production on pastureland areas and excellent ham production technology (Jamon Ibérico) leaded to fame and recognition of Spanish products around the world. Moreover, production technology is strengthened by law regulations (Royal decrees 2007 and 2014), which protect and stabilize the quality of final products. Iberian pigs, as a genetic recourses, are also under regulations concerning on the pigs' origin, treatment and breeding. Additionally, the labelling of regional products have been defined for easy identification of the breeding and feeding system of Iberian pigs. All the above actions are an good example of state's concern for the interest of both, consumers and producers, which also positively influence on promotion of dried ham (Jamon Ibérico) in many places around the world.

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Streszczenie: *Przykład systemu produkcji wysokojakościowych produktów z wieprzowiny.* Celem artykułu było przedstawienie hiszpańskiego modelu produkcji szynek suszonych Jamon Ibérico. Wieloletnie doświadczenie Hiszpanów w ekstensywnym tuczu świń iberyjskich z wykorzystaniem potencjału obszarów pastwiskowo-leśnych zwanych dehesa oraz dopracowanie technologii produkcji szynek w powolnym procesie suszenia sprawia, że otrzymany produkt (Jamon Ibérico) charakteryzuje się bardzo dobrą jakością (potwierdzoną badaniami naukowymi) i smakowitością (niespotykanym w innych produktach aromacie mięsa). Ustanowione regulacje prawne tej produkcji w dekretach królewskich wydanych w 2007 roku, a następnie w 2014 roku wprowadziły wiele przepisów mających na celu poprawę i stabilizację jakości produktu końcowego. Dbając o bezpieczeństwo zasobów genetycznych świń rasy iberyjskiej, zaostrzono przepisy dotyczące pochodzenia zwierząt, sposobu ich traktowania oraz metod hodowli. Ponadto określono warunki etykietowania produktów regionalnych, które umożliwiają identyfikację systemu chowu i sposobu żywienia świń

iberyjskich poprzez umieszczanie odpowiednich oznaczeń na etykietach gotowych produktów. Powyższe działania są przykładem troski Hiszpanii o interes zarówno konsumentów, jak i producentów wieprzowych produktów iberyjskich. Przy jednocześnie prężnie działającym systemie promocji szynka suszona Jamon Ibérico znana jest nie tylko w Hiszpanii, ale i w całej Europie.

Słowa kluczowe: świnie Ibérico, tucz, produkt regionalny, regulacje prawne

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Authors' address:
Magdalena Szyndler-Nędza
Zakład Hodowli Trzody Chlewnej
Instytut Zootechniki – PIB
ul. Krakowska 1
32-083 Balice, Poland
e-mail: magdalena.szyndler@izoo.krakow.pl