

## Smoked vs Dry-cured *Alentejano* and white pig loins

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### SUMMARY

This study aim is to evaluate the characteristics of both types of pig loins from *Alentejano* and White pigs, manufactured with distinguish processes, taking in account that smoked technology is most appreciated in Portugal, than in the other European countries, whom preferences stands in cured products by drying technology. In the study, 6 *Alentejano* pigs, crossbred at 50% with Duroc and reared in free-range system, classified as class 2 by decree-law n°95/2014, and 6 crossbred White pigs, reared in intensive system were used, weighting 120 kg and 100 kg, respectively, after slaughtering. The loins processing was in "Salsicharia Estremocense Lda". The evaluation between *Alentejano* breed and White crossbred loins, smoked and dry-cured, were made physical and chemical analysis (pH, aW, WHC, moisture content, ash, fat, protein, TBARS, TVB-N) and sensory analysis (QDA). No significant differences were showed in pH, moisture and WHC in the loins processed by the two technologies, as well as in the nutritional value. Lipid profile also had not shown significant differences, nor even due to the breed neither to the technology, however it should be highlighted that the *Alentejano* loins had an amount of 13% fat while the Exotic loins had shown 8% fat content. The TVB-N content was higher in *Alentejano* loins, for both technologies, and TBARS varies along the processing, however this parameter didn't distinguish the different technologies. There were significant differences between the breeds and the technologies in sensory color and bitter taste. The sensory analysis heightens, in the two breeds, the smoked technology, and thus the panellists overall acceptability.

### Lomos de cerdo *Alentejano*

### RESUMO

Este estudo pretende avaliar as características dos dois tipos de lombo de porco, *Alentejano* e Branco, processados com tecnologias distintas, a fumaça, apreciada em Portugal, ao contrário dos restantes países da Europa que preferem produtos que utilizam exclusivamente a secagem para obter um produto curado. Utilizaram-se 6 porcos de Raça *Alentejana*, cruzados a 50% com Duroc, criados em regime extensivo, classificados como classe 2 pelo decreto-lei n°95/2014 e 6 porcos cruzados brancos, criados em regime intensivo. Com peso após o abate 120 kg e 100 kg., respectivamente. O processamento dos lombos decorreu na Salsicharia Estremocense. A avaliação entre lombos de porco de raça "Alentejana" e brancos cruzados, fumados e secos, foi realizada com base em análises físico-químicas (pH, aW, CRA, Humidade, Cinza, Gordura total, Proteína bruta, Fibra, ABVT e TBA), e sensorial (prova QDA). O pH, Humidade, CRA não apresentam diferenças significativas, entre os lombos elaborados com diferentes tecnologias, assim como em relação ao valor nutricional. O perfil lipídico também não apresentou diferenças significativas, nem quanto à raça nem quanto à tecnologia, no entanto devemos realçar que os lombos de porcos de raça "Alentejana" apresentam um conteúdo da gordura da ordem dos 13% enquanto os lombos de porco branco cruzado apresentam valores de 8%. O Azoto Básico Volátil Total apresenta teor mais elevado nos lombos de porco *Alentejano* em ambas as tecnologias, o TBA varia ao longo do processamento, mas não distingue as duas tecnologias. Verificam-se diferenças significativas entre raças e tecnologias na cor e sabor amargo. A análise sensorial apresenta maior grau de aceitação pelos provadores nos produtos fumados em ambas as raças.

### ADDITIONAL KEYWORDS

Sensory analysis.  
Fatty acids.  
TBARS.  
NPN.

### PALAVRAS CHAVE ADICIONAIS

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### INTRODUCTION

The Celtic learns the art to manufacture cured meat products and to store pork meat with the romans, and from so on this philosophy stills benefits the Portuguese. It's was also this civilization the responsible for meat industry development, with the early slaughterhouses. Arabs were responsible for spices introduction in cured meat products (Mendonça, 2012). These traditional products contributed to rural development and to its valorization, conserving the natural

environmental conditions. These products respect the ecosystems, its biodiversity and the genetic heritage. Along time these products achieve a highlight position in consumer's preference, which are in disposition to pay a fair price for the quality associated to an origin, to a way of production and to a unique sensory characteristic (Ferro Palma, 2006).

### MATERIAL AND METHODS

In the study, 6 *Alentejano* pigs, crossbred at 50% x Duroc and reared in free-range system, classified as class 2 by decree-law n°95/2014, and 16 crossbred white pigs, reared in intensive system were used, weighting 120 kg and 100 kg, respectively, after slaughtering in Slaughterhouse of Alto Alentejo (Sousel). After sampling, and in order to compare both *Alentejano* and crossbred white pigs breeds loins, smoked and dry-cured, physical, chemical and sensory analysis were made at 0, 40, 120 and 180 days. However sensory analysis was only made at 120 and 180 days after maturation. The pH was determined by NP 3441:2008, moisture content by NP 1614:1979. To determine Water Hold Capacity (WHC) was used the pistometric method (Grau & Hamm, 1953), the TVB-N was determined by NP 1848:1987, NNP by De Ketalere (1974) and the TBARS by the method describe by Tarladgis et al. (1960), fat content by NP 1613:1979 and fatty acids by gas chromatography GC-FID. In the sensory analysis was done a Quantitative Descriptive Analysis (QDA) with a scale from 1 to 9 scores. All physical, chemical and sensory parameters were statistically analyzed by SPSS Statistics version 23, and the means, standard deviation were considered by ANOVA analysis with a significance level 0.05 and using comparison means by Scheffé test.

## RESULTS AND DISCUSSION

The pH values in *Alentejano* pig range from 6.1 to 5.86 for the smoked one, and 6.01 to 5.94 for the dried one. For the white pig loin, the values range from 5.49 to 5.69 for the smoked and 5.49 to 5.55 for the dried one. This values are in agreement with a case study about the influence of the processing method on the *Alentejano* cured loin quality, where the values obtained were 6.28 to 5.71 along the smoking process, and the dried ones had pH from 6.28 to 5.76 (Ferro Palma, 2006). Another study (Lorenzo et al. 2013), obtained pH of 5.90 at 60 days, which is in accordance to those

obtained in our study. Thus the pH along the loins processing with the different technologies did not presented significant differences between the technologies in the same breed; however, it had significant differences between the breeds.

The TVB-N content dry matter (dm) in *Alentejano* loins range from 9.32 mg/g to 8.89 mg/g in the smoked, and 9.97 mg/g to 11.13 mg/g in the dried one. In the White pigs' loins, the values range from 10.12 mg/g to 12.95 mg/g for the smoked and 13.57 mg/g to 13.67 mg/g in the dried. This values of TVB-N are in accordance with those found in other studies related with the influence of the processing method on the *Alentejano* cured loin quality, where the values obtained were 13,98 mg/g (dm) and 15.77 mg/g (dm) along the smoking stage and 13.98 mg/g (dm) to 19.92 mg/g (dm) for the dried loins

TVB-N values in *Alentejano* pig loins range from 11.27 mg/100g to 207.32 mg/100g for the smoked and 11.27 mg/100g to 248.66 mg/100g for the dried loins. In the meanwhile, for the white pig loin the values rage from 10.76 mg/100g to 75.70 mg/100g for the smoked loins and from 10.76 mg/100g to 124.97 mg/100g for the dried loins (Figure 1).

Non-Protein Nitrogen (NPN) data in *Alentejano* pig loins were between 6.09 mg/g and 5.94 mg/g for the smoked loins and 6.33 mg/g to 7.18 mg/g for the dried ones. In the white pig loins, the data were 5.83 mg/g and 8.00 mg/g for the smoked loins and 7.70 mg/g to 7.82 mg/g for the dried ones. In terms of data expressed in dry matter, the *Alentejano* pig loins had values from 9.32 mg/g and 8.89 mg/g for the smoked loins (PF), and between 9.97 mg/g and 11.13 mg/g for the dried loins (PS). For the white pig loins, the values range from 10.12 mg/g to 12.95 mg/g for the smoked loins (BF) and 13.57 mg/g to 13.67 mg/g in the dried ones (BS). There were significant differences between the two breeds in the values expressed in dry matter at 40 and 120 days. This NPN (dm) were in accordance with the values found in studies related with the influence of the processing system in *Alentejano* cured loin quality (Ferro Palma, 2006).

Fat content values are in accordance with those found in other studies related with the influence of the processing method on the *Alentejano* cured loin quality, where the values obtained in dry basis were between 13.15% to 13.87% during smoking process, and 13.15% to 15.90% for the dried loins (Ferro Palma, 2006). Lorenzo et al. (2013) had 3.41% of fat content at 60 days, which is in accordance with this study. The total fat content values in *Alentejano* pig loins range from 13.43% to 10.92% for the smoked, and from 6.65% to 12.46 % for the dried one. In the white pig loins, the values were from 8.30% to 5.48 % for the smoked and 7.28 % to 5.85% in the dried loins.

The fatty acids values at 120 days in both technologies are presented in Table I, which show that there weren't significant differences in the majority of fatty acids in the products from the different technologies. Only two fatty acids presented significant differences, the oleic acid and linolenic acid. The oleic acid values are in accordance with a study related with the influen-

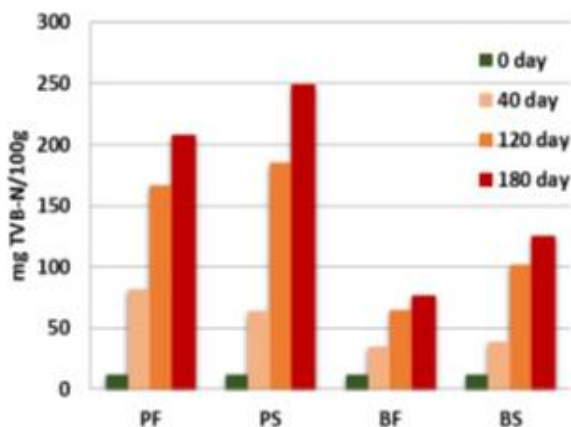


Figure 1. mg TVB-N/100g loin sample: PF (Smoked *Alentejano* Pig); PS (Dry-cured *Alentejano* Pig); BF (Smoked White Pig); e BS (Dry-cured White Pig). (P≤0,05) (mg ABVT/100g, em lombos curados nas diferentes etapas de elaboração PF (Porco *Alentejano* Fumado); PS (Porco *Alentejano* Seco); BF (Porco branco Fumado); e BS (Porco branco Seco). (P≤0,05).

**Table I.** Fatty acids percentage at 120 days in smoked and dried loins (g/100 g) (Percentagem de ácidos gordos aos 120 dias lombos fumados e secos (g/100 g).

	PF	PS	BF	BS
	0.08(0.01) <sup>a</sup>	0.08 (0.01) <sup>a</sup>	0.07 (0.00) <sup>a</sup>	0.07 (0.01) <sup>a</sup>
	1.33(0.06) <sup>a</sup>	1.27 (0.13) <sup>a</sup>	1.18 (0.04) <sup>a</sup>	1.24 (0.08) <sup>a</sup>
	26.36(1.46) <sup>a</sup>	25.87 (0.88) <sup>a</sup>	26.19 (0.21) <sup>a</sup>	26.53 (0.49) <sup>a</sup>
C16:1cis-9	3.64(0.45) <sup>a</sup>	3.21 (0.64) <sup>a</sup>	2.85 (0.00) <sup>a</sup>	3.54 (0.18) <sup>a</sup>
C17:0	0.13(0.03) <sup>a</sup>	0.18 (0.02) <sup>a</sup>	0.22 (0.03) <sup>a</sup>	0.19 (0.04) <sup>a</sup>
C17:1cis-9	0.16(0.04) <sup>a</sup>	0.16 (0.01) <sup>a</sup>	0.21 (0.01) <sup>a</sup>	0.20 (0.04) <sup>a</sup>
C18:0	11.81(1.60) <sup>a</sup>	13.54 (0.88) <sup>a</sup>	12.93 (0.02) <sup>a</sup>	11.92 (0.13) <sup>a</sup>
C18:1cis-9	46.37(0.14) <sup>a</sup>	42.81 (1.24) <sup>b</sup>	45.03 (0.56) <sup>ab</sup>	44.90 (0.29) <sup>ab</sup>
C18:1cis-11	4.27(0.48) <sup>a</sup>	3.93 (0.45) <sup>a</sup>	3.70 (0.05) <sup>a</sup>	4.21 (0.08) <sup>a</sup>
C18:2 $\eta$ -6	3.88(1.67) <sup>a</sup>	6.11 (2.11) <sup>a</sup>	5.08 (0.69) <sup>a</sup>	5.02 (0.63) <sup>a</sup>
C18:3 $\eta$ -3	0.73(0.06) <sup>ab</sup>	0.69 (0.06) <sup>b</sup>	0.99 (0.01) <sup>a</sup>	0.75 (0.11) <sup>ab</sup>
C20:0	0.18(0.01) <sup>a</sup>	0.21 (0.01) <sup>a</sup>	0.22 (0.01) <sup>a</sup>	0.17 (0.04) <sup>a</sup>
C20:3 $\eta$ -6	0.09(0.04) <sup>a</sup>	0.16 (0.04) <sup>a</sup>	0.14 (0.02) <sup>a</sup>	0.14 (0.03) <sup>a</sup>
C20:4 $\eta$ -6	0.77(0.56) <sup>a</sup>	1.50 (0.27) <sup>a</sup>	0.88 (0.04) <sup>a</sup>	0.87 (0.22) <sup>a</sup>
C22:0	0.03(0.01) <sup>a</sup>	0.04 (0.00) <sup>a</sup>	0.07 (0.02) <sup>a</sup>	0.04 (0.01) <sup>a</sup>
C22:5 $\eta$ -3	0.05(0.04) <sup>a</sup>	0.12 (0.04) <sup>a</sup>	0.08 (0.01) <sup>a</sup>	0.09 (0.03) <sup>a</sup>
outros AG	0.14(0.04) <sup>a</sup>	0.17 (0.02) <sup>a</sup>	0.20 (0.04) <sup>a</sup>	0.16 (0.01) <sup>a</sup>

The values expressed in means  $\pm$  standard deviation. distinct index different levels of significance ( $P \leq 0.05$ ); the letters (a.b.c. ) indicate differences between columns The products expressed by PF (Smoked *Alentejano* Pig); PS (Dry-cured *Alentejano* Pig); BF (Smoked White Pig); e BS (Dry-cured White Pig)

Os valores expressos em média  $\pm$  o erro padrão. os distintos índices indicam diferentes níveis de significância ( $P \leq 0.05$ ); as letras (a.b.c...) indicam diferenças entre colunas e os números (1.2.3...) diferenças entre filas

Os produtos expressam-se por abreviaturas: PF (Porco *Alentejano* Fumado); PS (Porco *Alentejano* Seco); BF (Porco Branco Fumado); e BS (Porco Branco Seco)

ce of the breed and feed in the intramuscular fat characteristics and content in Iberian pig loin, which had oleic acid values of 58.08% (Canillas, 2006); and other study obtained oleic acid between 52.13 % and 50.68 % Toribio, (2011), which is in accordance with this study.

The linolenic acid values are in accord with a study related with the influence of the breed and feed in the intramuscular fat characteristics and content in Iberian pig loin, which had linolenic acid values of 0.21% to 0.27% (Canillas, 2006).

The fatty acid in major amount in the all four products is the C18:1cis-9, with a percentage from 46.37% e 42.81%, followed by the C16:0, with amounts of 26.53% and 25.87%. The MUFA (Figure 2) are in higher amount in the loins, and therefore the MUFA in *Alentejano* pig loin are 54.45 % for the smoked and for the dried. In the white pig loin, the values are 51.75% for the smoked loins and 52.85% for the dried ones. Serna, (2013) had made a comparison between the “Murciano” pig and the “White” pig, obtaining the values of 62.02% for the “Murciano”, and 57.68% for the “White” and values of PUFA 4.7% for the “Murciano”, and 9.32% for the

“White”, which are in consonance with those obtained in this study

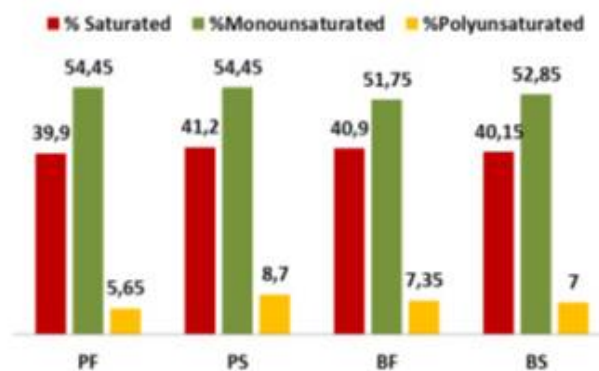


Figure 2. % Fatty acid at 120 days in dry-cured loins: PF (Smoked *Alentejano* Pig); PS (Dry-cured *Alentejano* Pig); BF (Smoked White Pig); e BS (Dry-cured White Pig). ( $P \leq 0,05$ ) (% de ácidos gordos aos 120 dias nos lombos curados: PF (Porco *Alentejano* Fumado); PS (Porco *Alentejano* Seco); BF (Porco branco Fumado); e BS (Porco branco Seco) ( $P \leq 0,05$ ).

Related with TBARS in dry matter, along the stages of both processing technologies, this parameter didn't distinguish the different technologies. The TBRAS values in *Alentejano* pig loins ranges from 0,38 µgMDA/g to 0.21 µgMDA/g for the smoked one and 0.38 µgMDA/g to 0.14 µgMDA/g for the dried loins. In the white breed, for the smoked loins the TBRAS values were between 0,36 µgMDA/g and 0.15 µgMDA/g and for the dried loins between 0.36 µgMDA/g and 0.19 µgMDA/g (Figure 3).

The TBRAS data in dry matter are in accord with values found in studies related with the influence of the processing method on the *Alentejano* cured loin quality, which obtained values from 1.85 µgMDA/g and 0.97 µgMDA/g during smoking process, and from 1.85 µgMDA/g and 5.58 µgMDA/g for the dried loins (Ferro Palma, 2006). Lorenzo et al. (2013)., obtained TBARS of 1.13 µgMDA/g at 60 days, which fact is in accordance with the values obtained in this study.

The TBARS value is superior at 40 days, and decreases along the process, possibly due to manolaldeide among other volatile compounds characteristics of the aroma and taste.

Color sensory evaluation in *Alentejano* pig loin scores from 6.90 to 7.30 for the smoked and 7.42 to 6.92 for the dried loins, which were quite different from the values found in a study related with the influence of processing system in the *Alentejano* cured loin quality, since in these study the score for this parameter was 3.92 along the smoking process and 5.47 for dried loins (Ferro Palma, 2006). However, In the White breed, the scores reach from 3.64 to 4.21 for the smoked loins and 2.43 to 3.57 in the dried ones. Marbling in *Alentejano* pig loins were between 5.20 and 5.50 for the smoked and 4.17 to 4.67 for the dried, while in the White loins the scores were 5.00 and 5.50 for the smoked ones and 5.07 in the dried loins were 4.43. In *Alentejano* pig loins

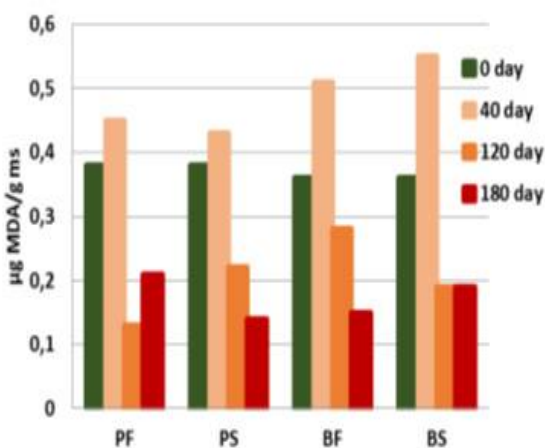


Figure 3. TBARS - µg MDA/g of loin sample dry matter: PF (Smoked *Alentejano* Pig); PS (Dry-cured *Alentejano* Pig); BF (Smoked White Pig); e BS (Dry-cured White Pig). (P≤0,05) (TBA - µg MDA /g de residuo seco de lombos curados fumados e lombos curados secos nos diferentes dias de elaboração PF (Porco *Alentejano* Fumado); PS (Porco *Alentejano* Seco); BF (Porco branco Fumado); e BS (Porco branco Seco). (P≤0,05)



Figure 4. Loins Overall acceptability: PF (Smoked *Alentejano* Pig); PS (Dry-cured *Alentejano* Pig); BF (Smoked White Pig); e BS (Dry-cured White Pig) (P≤0,05) (Aceitabilidade global dos lombos: PF (Porco *Alentejano* Fumado); PS (Porco *Alentejano* Seco); BF (Porco branco Fumado); e BS (Porco branco Seco). (P≤0,05).

the flavor intensity was scored from 5.70 and 5.60 for the smoked and 6.33 and 6.00 for the dried, however in the study related with the influence of processing systems in *Alentejano* pig loins quality, for the smoked the score was 4.19 and on the dried loins was lower scored 3.97 (Ferro Palma, 2006). In the White loins the scores were 3.93 and 5.14 for the smoked ones and 5.43 in the dried loins were 5.14 (Figure 4). Smoke flavor in *Alentejano* pig loins were between 3.30 and 6.00 for the smoked and 5.00 for the dried, and in the White breed were 3.64 and 3.93 for the smoked ones and in the dried loins were 4.00 and 3.71. Rancid flavor in *Alentejano* pig loins were between 2.50 and 1.60 for the smoked loins and scored 1.92 and 2.08 for the dried ones, while on the White breed loins were lower as it was expected, with scores from 1.70 and 2.00 for the smoked ones, and 1.29 to 1.36 in the dried ones. Indeed these results were in consonance with the previous data in fat content, which were significantly higher in the *Alentejano* loins (40.72% and 31.51% for the smoked, and 18.58% and 36.55 % for the dried loins, and in the White loins, the values range from 13.91% to 9.25% for the smoked ones and from 12.80% to 10.21% in the dried ones). In a study concerning the sensory characteristics of cured Iberian pigs related with the crossbreed and the reared systems influence, had obtained scores from 1.83 to 2.27 (Ventanas, et al., 2006), which are in accordance with those obtained in this study.

In the overall acceptability, the *Alentejano* pig loins scored 4.90 to 6.70 for the smoked loins, and 4.42 to 6.00 in the dried loins, while in the White pig loins, the score was 6.57 and 6.07 for the smoked ones and 5.07 to 6.07 for the dried loins.

In conclusion, the main three goals of this study were achieved when comparing two technologies in two pigs breeds. Thus with this study it's possible to conclude that *Alentejano* smoked loin and *Alentejano* dried loin presented physical, chemical, sensory and

textural characteristics very similar, and the main difference was related with smoke and its acceptability by the panelists. The sensory evaluation of color and hardness were the only sensory parameters with significant differences either between breeds and technologies. The sensory analysis heightens, in the two breeds, the smoked technology, and thus the panellists overall acceptability in both smoked products with 180 days and 120 days.

## ACKOWLEGMENTS

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