The effect of genotype on chemical properties of Istrian dry-cured ham

The effect of genotype on chemical properties of Istrian dry-cured ham

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Summary

The aim of this study was to determine how different genetic backgrounds (particularly effect of Duroc as a terminal carcass breed) affect chemical composition (water content, as well as dry matter, protein, fat, and NaCl content), as well as other properties of Istrian dry-cured ham (pH, acid number, peroxide number) that are significant in sense of its quality. For this purpose 10 pigs (Large White, ♀x German Landrace, ♂) x Duroc ♂ - (LWxGL)xD genotype and 10 pigs Swedish Landrace,♀x Large White, ♂ - (SLxLW,) genotype were slaughtered, and the hams were processed according to the Istrian manner, assuming that the hams of the (LWxGL)xD genotype will have a higher proportion of more desirable intramuscular fat, which will ultimately affect positively the overall quality of the dry-cured ham. The analyses showed the following: more dry matter (63.00% vs. 57.86%) and less water content (37.00% vs. 42.14%) were found in the hams of the (LWxGL)xD genotype related to the hams of the SLxLW genotype (P <0.001); while the content of proteins in the hams of two different genotypes was not statistically different, the fat content in the (LWxGL)xD hams was significantly higher (16.12% vs. 11.76%) than in SLxLW hams(P <0.001), while the content of NaCl (8.29% vs. 9.04%) was lower (P <0.01), which was expected due to the lower fat content in these hams. There was no statistically significant difference in pH of the hams of the two genotypes (6.18 Vs. 6.13). Contrary to expectations, acid and peroxide numbers were higher in the hams with higher fat content - (LWxGL)xD genotype. Moreover, both of the parameters were higher in the hams of the SLxLW genotype, however, a statistically significant difference (P <0.001) was detected only in acid number (22.10mg KOH vs. 38.50 mg KOH). In general, it can be concluded that the use of the Durocas, a terminal carcass breed, can contribute to the total quality of dry-cured ham. In fact, these hams have a higher content of desirable intramuscular fat, which also affects positively the reduction of salt in the ham. However, there are no negative effects on the degree of fatty acid oxidation (peroxide number), and there is a positive effect on the degree of fatty acids hydrolysis (lower acid number).

Keywords: *Istrian dry-cured ham, pig genotype, Duroc, chemical properties of dry-cured ham*

Introduction

Uneven quality of hams intended for the production of dry-cured hams is a result of different genotypes, technology of breeding and feeding of pigs, age, sex and body mass, handling pigs *ante* and *post mortem*, their morphological characteristics, content of fat and muscle tissue in the ham, which all affects the quality of dry-cured ham, along with the processing technology. Defining convenient genetic lines and crossbreds the most suitable for the production of dry-cured hams of optimal quality is one of the basic goals of research which should contribute to solving problems of disparity in quality in dry-cured hams which has been done for Croatian traditional kinds of dry-cured hams (Istrian, Dalmatian and Drniš) along with the standardization of technology in breeding and fattening of pigs and technology of processing dry-cured hams, in procedures of the protection of geographical indication of origin.

Considering the fact that carcass traits are the basis for determining the price of pig carcasses, as terminal breed in breeding pigs for the production of meat there are used boars of fleshy breeds (Pietrain or Belgian Landrace), the meat of which is not the best raw material for the production of dry-cured hams (PSE - pale, soft and exudative meat, low content of fat, especially intramuscular fat, etc.). Therefore, due to its favorable characteristics, as terminal breed for many years now Duroc boars, which are characterized by resistance, high growth rate and meat with an increased content of intramuscular fat (Šimek et al., 2004) are used. That is desirable in the production of cured meat products, especially dry-cured ham. In these terms many researches were conducted (Oliver et al., 1994; Guerrero et al., 1996; Ramiro et al., 1999c; García-Ray et al., 2006; Cilla et al., 2006; Soriano et al., 2005; Carrapiso and García, 2008; Peloso et al., 2010). One can conclude from them that breeding methods significantly affect the quantitative and qualitative characteristics of hams and dry-cured hams.

Duroc breed is characterized by a good resistance to stressors and a good quality of meat due to which it is used in different crossbreeding (Rosario Ramírez and Cava, 2007), although it is used most frequently as the final or terminal breed. Except for that, Duroc is used in such crossbreeding with a goal of increasing the share of intramuscular fat (marbling), especially in the programs of crossbreeding where there are included the breeds Belgian Landrace, Pietrain and German Landrace, in which the share of intramuscular fat was decreased below the optimal 2 - 3 % (Uremović and Uremović, 1997). Belgian Landrace and Pietrain are highly sensitive to stress, so the appearance of PSE meat is quite frequent, as well as a high level of non-protein nitrogen (NPN) and tyrosine in dry-cured hams (Guerrero et al., 1996), then weaker organoleptic traits of dry-cured ham (Gallo et al., 1994). Moreover, in the production of cured meat products branded as "Iberian" due to the listed positive characteristics of the Duroc breed, except for the meat of the Iberian pig, the usage of meat of crossbreds of the Iberian pig (mother line) and Duroc is also allowed (Rosario Ramírez and Cava, 2007). But, due to the coarser structure of muscle fibers, the meat of crossbreds with a larger proportion of Duroc is of weaker texture (Gou et al., 1995), so this breed is also used as terminal breed in breeding. Furthermore, crossbreds with Duroc as terminal breed (♂) grow faster and have better feed conversion (Blasco et al., 1994). With Italian crossbreds with different percentages of Duroc and Large White, there was noticed a positive correlation between the mass of a freshly treated ham and % of water, marbling and consistency of muscle tissue in a mature dry-cured ham, and as a reason there is listed the activity of proteolytic enzymes in a raw ham and mature dry-cured ham (Schivazzapa et al., 1998). The crossbreds of Large White, Landrace and Duroc with different proportions of Duroc and Landrace breeds are most frequently used in breeding pigs for the production of dry-cured hams. Breeding methods undoubtedly affect the changes of chemical composition of meat, which are often sufficient for an important influence on quality and organoleptic traits of dry-cured hams.

Considering the above listed, the premise of this paper is that intramuscular tissue of dry-cured hams of different pig genotypes will have different chemical compositions, in which process the share of intramuscular fat (the degree of marbling) will be significantly higher in crossbreds with Duroc, which will then influence the share and oxidative status of free fatty acids in dry-cured hams.

Material and methods

Production of dry-cured hams: In a prolonged fattening until the final body weight of 160 - 200 kg there were fattened 20 pigs of two different genotypes (10 of each genotype):

- F1, ♀ (Large White, ♀ x German Landrace, ♂) x Duroc, ♂ - (LWxGL)xD
- Swedish Landrace, ♀ x Large White, ♂ - SLxLW

After the slaughter, cooling and cutting the carcasses and processing of hams, 20 hams of each genotype group (total of 40) were subjected to processing according to the traditional Istrian technology (processing ham with pelvic bones, without the skin and subcutaneous fatty tissue; dry brining with sea salt with the addition of spices, pressing, drying and maturing). Taking and preparing of samples of muscle tissue of dry-cured hams was performed by the method of Krvavica et al. (2008).

Chemical analyses of muscle tissue of dry-cured hams: The content of water and dry matter was determined by drying of 200 grams of a homogenized sample at the temperature of 105°C until a constant mass is reached. The loss of mass is expressed as the percentage of water in a sample. The content of total protein was determined by the Kjeldahl method using a nitrogen analyzer Kjel-Foss, type 16200. The content of intramuscular fat was determined by the Stoldt method (HRN ISO 1443:2002). The content of NaCl in the samples was determined titrimetrically (James, 1999). The measurements of pH value of a homogenized sample were performed by a core pH-meter. Acid number as an indicator of the content of free fatty acids (HRN EN ISO 660:2004) and peroxide number as an indicator of primary oxidation of fatty acids (HRN EN ISO 3960:1999) were determined by standard methods.

Statistical data analysis: Descriptive statistics ($\overline{X}$ mean, minimum - Min, maximum - Max, standard deviation - Sd, standard error of the arithmetic mean - SE, coefficient of variation- CV) of the indicators of the basic chemical composition, content of NaCl, pH value, acid and peroxide number of dry-cured hams were calculated using MEANS procedures of the software package SAS V8 (SAS Institute, 1999). The estimation of the efficacy of the genotype to the researched quality indicators of dry-cured hams (chemical composition, content of NaCl, pH value, acid and peroxide number) was performed by applying variance analysis using GLM procedure (General

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Linear Models) of the software package SAS V8 (SAS Institute, 1999) according to the model shown below. The results are expressed as means obtained by the least squares method (LSMEAN- least squares means) ± standard error (SE - *standard error*).

Model ANOVA: $Y_{ij} = \mu + T_i + e_{ij}$
Where there are:
Y_{ij} - measured value;
μ - total mean value;
T_i - genotype effect (i= 1,2);
e_{ij} - unexplained effect

Results

Basic chemical composition, share of NaCl and pH and indicators of share and oxidative status of free fatty acids of muscle tissue of Istrian dry-cured meat (regardless of the genotype) are presented in Table 1, where the following is shown:

- The share of dry matter in dry-cured hams amounted to an average of 60.43±3.25%, water 39.57±3.24%, protein 37.92±2.97% and fat 13.94±3.23%. The highest coefficient of variation was determined for the share of fat (23.17%) and even though it is below the limit of 30% itself, so it can be considered that the sample is relatively homogenous in terms of fat content too, whereas variations of other components (dry matter, water and protein) were markedly low (5.37 to 8.19%).
- The content of salt in dry-cured hams amounted 8.68±0.71% on average with a low coefficient of variation of 8.22%.
- Average pH value was 6.16±0.23, with markedly low coefficient of variation (3.75%), which indicated to sample homogeneity and stability of pH value of dry-cured hams in comparison to the possible influence of the genotype and other factors.
- Average acid number of dry-cured hams was 30.35±10.79 mg KOH/g fat, and average peroxide number 14.45±8.31 meq O_2/kg of the sample, with high coefficients of variation (57.53% and 35.56%).

Table 1 **The basic chemical composition, salt content, pH, acid and peroxide number of the ham**

	$\overline{\chi}$	Sd	SE	Min	Max	CV, %
Dry matter, %	60.43	3.25	0.73	53.20	65.70	5.37
Water, %	39.57	3.24	0.73	34.30	46.80	8.19
Protein, %	37.92	2.97	0.66	31.80	43.90	7.82
Fat, %	13.94	3.23	0.72	9.40	19.30	23.17
NaCl/salt, %	8.68	0.71	0.16	7.03	9.39	8.22
pH	6.16	0.23	0.05	5.50	6.50	3.75
Acid number, mg KOH	30.35	10.79	2.41	16.00	53.00	57.53
Peroxide number, meq O_2	14.45	8.31	1.86	2.00	30.00	35.56

$\overline{\chi}$ - mean; Sd- standard deviation; SE-standard error; CV-coefficient of variation

Table 2 **The effect of genotype on basic chemical composition (%), salt content (%), pH, acid and peroxide number of the hams (LSM)**

	(LWxGL)xD	SLxLW	SE	LS
Dry matter, %	63.00	57.86	0.62	***
Water, %	37.01	42.14	0.62	***
Protein, %	38.13	37.70	0.96	NS
Fat, %	16.12	11.76	0.76	***
NaCl/salt, %	8.29	9.04	0.19	**
Ph	6.18	6.13	0.07	NS
Acid number, mg KOH	22.20	38.50	2.22	***
Peroxide number, meq O2	11.10	17.80	2.46	NS

SE= standard error; LS= level of significance; *** (P<0.001); ** (P<0.01); NS=not significant (P>0.05)

Table 2 presents to which extent different genotypes of the pigs influenced the researched characteristics of dry-cured hams:

- that the share of dry matter in muscle tissue of dry-cured hams of the genotype (LWxGL)xD was higher than in muscle tissue of dry-cured hams of the genotype SLxLW (63.00% vs. 57.86%; P<0.001);
- considering the share of dry matter, the difference in content of water in dry-cured hams between the genotype (LWxGL)xD and the genotype SLxLW was also statistically very highly significant (37.01% vs. 42.14%; P<0.001);
- the determined differences of average values of the content of protein in muscle tissue of dry-cured hams of the genotype (LWxGL)xD and the genotype SLxLW were not statistically significant (38.13% vs. 37.70%; P>0.05);
- the content of fat was significantly higher (P<0.001) in dry-cured ham of the genotype (LWxGL)xD (16.12%) in comparison to the genotype SLxLW (11.76%);
- the content of NaCl in dry-cured ham of the genotype (LWxGL)xD (8.29%) was significantly lower (P<0.01) than in the dry-cured ham of the genotype SLxLW (9.04%);
- the determined difference in pH values of dry-cured hams of the genotype (LWxGL)xD and SLxLW (6.18 vs. 6.13) was not statistically significant;
- acid number of muscle tissue of dry-cured ham of the genotype (LWxGL)xD was lower (22.20 mg KOH) than the acid number of dry-cured ham of the genotype SLxLW (38.50 mg KOH), whereby the determined difference was statistically very significant (P<0.001);
- the determined difference for peroxide number between the genotype (LWxGL)xD and the genotype SLxLW (11.10 vs. 17.80 meq O_2) was not statistically significant (P>0.05).

Table 3. **Chemical properties of several type of hams, %**

Type of ham	Dry matter	Water	Protein	Fat	Salt
Istrian[1]	65.60	34.40	39.85	19.66	6.83
Serrano[2]	51.50	48.50	33.10	5.90	8.70
Iberian[3]	51.00	49.00	24.60	20.50	6.50
Parma[4]	38.20	61.80	26.90	3.50	6.00
San Daniele[4]	39.60	60.40	27.60	3.60	6.50
Bayonne[5]	43.00	57.00	30.00	5.00	6.20
Country-stile[6]	36.00	64.00	24.80	5.30	4.70

[1] Krvavica, 2003; [2] Toldrá et al., 1997; [3] León-Crespo et al., 1986; [4] Baldini et al., 1992; [5] Toldrá, 2002; [6] Eakes et al., 1975.

It is visible from Graph 1 that along with the decrease in the content of fat, the content of NaCl expectedly increases in muscle tissue of dry-cured ham. Still, the increase in the content of fat in dry-cured ham did not have the expected effect on the increase of acid and peroxide number of dry-cured ham , but dry-cured hams of the (LWxGL)xD genotype with higher content of fat had significantly lower (P<0.001) content of free fatty acids (acid number) as well as a lower peroxide number, although a higher acid number of dry-cured ham of SLxLW genotype didn't have a significant effect to the degree of primary oxidation of free fatty acids (peroxide number).

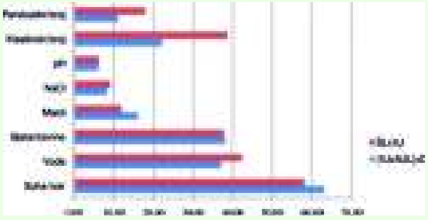
Discussion

When comparing the results of the research with the results of similar researches of other authors (Table 3) there can be noticed certain similarities and differences. The content of dry matter of muscle tissue of the researched dry-cured hams was significantly higher than of other types of dry-cured hams listed in Table 3 (except for the Istrian[1]), which is most probably the consequence of a higher loss of water in processing (weight loss) the researched dry-cured hams (as well as Istrian[1]), which were produced according to the traditional Istrian technology by processing them without the skin and subcutaneous fat tissue. It then results in higher exposure of the dry-cured ham to environmental conditions and faster drying (Karolyi, 2002; Krvavica, 2003). Furthermore, it can be noticed that the content of protein and fat of the researched dry-cured hams is significantly higher than of all other types of dry-cured hams (except for the Istrian[1], and fat with the Iberian one), which should be connected firstly with higher content of dry matter of the researched dry-cured hams.

Still, an increased content of fat is not only a result of a higher content of dry matter because differences in this sense are quite large. Moreover, if the content of fat is recalculated in comparison to dry matter, there is noticed even larger difference, as in comparison with other types of dry-cured hams, so between the researched dry-cured hams of two genotypes. Except for the influence of Duroc breed of (LWxGL)xD genotype, the fact that the researched dry-cured hams were produced from pigs of final body weights of over 160 kg explains additionally the listed higher content of fat in comparison to other types of dry-cured hams. In Table 3 there can also be noticed the largest fat content in muscle tissue of Iberian dry-cured ham that is traditionally produced from the autochthonous primitive Iberian pig breed (high level of marbling), which is also bred in a traditional way (pasture breeding).

As it can be seen from Table 2, there was determined a significantly lower content of fat in dry-cured hams of (LWxGL)xD genotype, which is a consequence of a higher content of fat in these dry-cured hams. But, in comparison with other types of dry-cured hams (Table 3) there can be noticed that the researched dry-cured hams contain a significantly higher content of salt than other types of dry-cured hams. The most similar to the researched hams by the content of salt is dry-cured ham Serrano[2] (Toldrá et al., 1997), whose production is based on industrial technology and pigs from conventional breeding (final body weight between 90 and 110 kg). A high content of salt of the researched dry-cured hams can't be explained with certainty due to the fact that hams of high quality were used as raw material and all applied technological procedures are in accordance with the traditional Istrian technology.

The pH values of the researched dry-cured hams do not differentiate from other similar types of dry-cured hams. So, Krvavica and Đugum (2007) list that pH value of a mature Istrian dry-cured ham (after 18 months) produced in a traditional Istrian way amounts 6.32, which is similar to the researched dry-cured hams. Furthermore, the research did not determine the influence of pig genotype to pH value of a mature Istrian dry-cured ham, which is in accordance with the researches of other authors who list that generally, the change in pH value of meat in processing depends on characteristics of raw material (kind and quality of meat) and the technology of processing (Krvavica, 2012) and that, as a rule, in cured meat products there



Graph 1 **The basic chemical composition (%), salt content (%), pH, acid and peroxide number of the hams of two genotype**

appears a mild and slow increase in pH value during drying and maturing, which is a result of accumulation of products of decomposition of muscle constituents (proteolysis), primarily proteins (Toldrá, 2002). So Karolyi (2002) lists the changes in pH values of Istrian dry-cured ham during processing (pH_{45min} = 6.40; $pH_{24hours}$ = 5.70; $pH_{6months}$ = 5.86; $pH_{1.5year}$ =6.13), in which process the listed pH value of the mature dry-cured ham (6.13) is very similar to this research (Tables 1 and 2).

From Table 2 and Graph 1 it is clearly visible that acid and peroxide numbers of the dry-cured ham of SLxLW genotype are higher than of (LWxGL)xD genotype, even though variance analysis determined that only the difference that was statistically important (P<0.001) was the difference in acid number the dry-cured hams, whereas the difference in peroxide number was not statistically important. The listed results on acid number of dry-cured hams indicate to the possible influence of genotype to the process of lipolysis in dry-cured ham during processing. Despite the expectations, i.e. opposite to the given hypothesis, the results show that acid and peroxide numbers of dry-cured hams with lower content of fat (SLxLW) are higher, especially acid ones whose difference was highly statistically important. To obtain more precise conclusions, it is necessary to determine precise contents of individual free fatty acids in the ham through the cycle of processing. Previous researches show that the influence of genotype in this sense is clearly present, considering the fact that pig genotype significantly influences the content and activity of endogenous enzymes (Rosell and Toldrá, 1998; Armero et al., 1999a, 1999b, 1999c), which are directly responsible for the course of lipolytic changes in tissues of dry-cured hams during maturing. Except for that, the content of fatty acids of a raw dry-cured ham also influences strongly the course of lipolysis (Coutron-Gambotti and Gandemer, 1999), in which process it is assumed that a larger content of unstable polyunsaturated fatty acids (PUFA) also conditions forced hydrolysis of fat.

Peroxide number of dry-cured ham also gives only an approximate data on the degree of oxidation of free fatty acids of dry-cured ham due to the fact that it is an indicator of primary oxidation of free fatty acids of dry-cured ham which reaches its maximum 2 to 4 months from the beginning of the process of processing, after which the quantity of hydroperoxide gradually decreases (Gandemer, 2002). As dry-cured ham is a product with a long period of maturing (12 to 18 months) during which there appeared secondary oxidation of free fatty acids, it is necessary to perform additional analyses (determining malondialdehide - MDA or a test of determining thiobarbituric acid, the so - called TBA test) for the precise estimation of the oxidative status of dry-cured ham.

Conclusion

It can be concluded from this research that using Duroc as terminal breed in breeding pigs intended for the production of dry-cured hams contributes to the total quality of dry-cured ham. Namely, the listed dry-cured hams have a higher content of desirable intramuscular fat, which affects favorably the decrease in content of salt in dry-cured ham, in which process an increased content of fat has no negative influence on the degree of primary oxidation of free fatty acids (peroxide number) and there is a positive influence on the decrease in a degree of hydrolysis of fatty acids (lower acid number), which is most likely the result of differences in fatty acid and endogenous enzymatic content of dry-cured hams of different genotype, that requires additional researches. Generally, the content of salt in the researched dry-cured hams is markedly high, so it would be desirable to apply some of the technological procedures with the goal of decreasing the content of salt in the final product (the addition of lower quantity of salt, desalting or shortening the stage of salting).

References

Armero, E., J.A. Barbosa, F. Toldrá, M. Baselga, M. Pla (1999a). Effects of the terminal sire and sex on pork muscle catepsin (B, B+L and H), cysteine proteinase inhibitors and lipolytic enzyme activites. Meat Science 51, 185-189.

Armero, E., M. Baselga, M-C. Aristoy, F. Toldrá (1999b). Effects of sire type and sex on pork muscle exopeptidase activity, natural dipeptides and free amino acids. *Journal* of the

The effect of genotype on chemical properties of Istrian dry-cured ham

SCIENTIFIC AND PROFESSIONAL SECTION

Einfluss des Genotyps der Schweine auf rohen geräucherten Schinken aus Istrien

Zusammenfassung

Das Ziel dieser Arbeit war zu bestimmen, in welchem Maße unterschiedliche genetische Basis (besonders der Einfluss von Durok als Terminalrasse) einen Eifluss auf die chemische Zusammensetzung (Inhalt von Wasser und Trockenmasse, Eiweißstoffe, Fett und NaCl) und auf andere Eigenschaften des rohen geräucherten Schinkens (Istarski pršut) aus Istrien (pH, Säure- und Peroxidnummer) bedeutend für seine Qualität, hat. Zu diesem Zwecke wurden 10 Schweine von Genotyp (großer Yorkshire, ♀ x deutscher Landras, ♂) x Durok, ♂ (GYxDL)xD und 10 Schweine von Genotyp schwedischer Landras, ♀ x großer Yorkshire, ♂ (SchLxGY) geschlachtet, unter der Voraussetzung, dass der Schinken von Genotyp (GYxDL)xD einen größeren Anteil des gewünschten intramuskulären Fettes enthalten wird, was endlich einen positiven Einfluss auf die gesamte Schinkenqualität haben wird. Durch die Analyse wurde folgendes festgestellt: ein größerer Aneil der Trockensubstanz (63,00 % vs. 57,86 %) und ein kleinerer Anteil vom Wasser (37,00 % vs. 42,14 %) wurde beim Schinken des Genotyps (GYxDL)xD in Bezug auf Genotyp SchLxGY (P<0,001) festgestellt, während sich der Anteil von Eiweißstoffen in den Schinken zweier Genotypen statistisch nicht unterschied; der Fettanteil in den Schinken (GYxDL)xD war statistisch bedeutend größer (16,12 % vs. 11,76 %) als in den Schinken SchLxGY (P<0,001), während der NaCl-Anteil (8,29 % vs. 9,04 %) kleiner war (P<0,01), was in Bezug auf den kleineren Fettanteil in den erwähnten Schinken zu erwarten war; es wurde kein bedeutender statistischer Unterschied hinsichtlich pH bei Schinken zweier untersuchten Genotypen (6,18 vs. 6,13) festgestellt; widersprechend des Erwarteten, waren Säure- und Peroxidnummern der Schinken nicht größer bei Schinken des Genotyps (GYxDL)xD mit größerem Fettanteil. Beide Parameter waren sogar größer in den Schinken des Genotyps SchLxGY, aber ein statistisch bedeutender Unterschied (P<0,001) wurde nur für Säurenummer (22,10 mg KOH vs. 38,50 mg KOH) festgestellt. Im Allgemeinen kann festgestellt werden, dass der Gebrauch von Durok als Terminalrasse in Schweinezucht bestimmt für Herstellung von rohem geräucherten Schinken der gesamten Schinkenqualität beiträgt, bzw. günstig ist. Die betreffenden Schinken haben einen größeren Anteil des gewünschten intramuskulären Fettes, was einen günstigen Einfluss auf den niedrigeren Salzanteil in Schinken hat, wobei der vergrößerte Fettanteil keinen negativen Einfluss auf Oxidationsgrad von Fettsäuren (Peroxidnummer) hatte, aber den Hidrolysengrad von Fettsäuren (niedrigere Säurenummer) positiv beeinflusste.

Schlüsselwörter: *roher geräucherter Schinken (Istarski pršut), Genotyp der Schweine, Durok, chemische Eigenschaften des rohen geräucherten SchinkensSommario*

INFLUENZA DEL GENOTIPO DEI MAIALI SULLE CARATTERISTICHE CHIMICHE DEL PROSCIUTTO ISTRIANO

Sommario

L'obiettivo di questo lavoro era determinare in quale percentuale la diversità genetica (specialmente l'infulenza del durok come la razza terminale) influisce sulla composizione chimica (contenuto dell'acqua e della sostanza secca, delle proteine, grasii e il NaCl) e su altre caratteristiche del prosciutto (valore pH, numero di acidità, numero di perossidi) è importante nel senso della sua qualità. Perciò sono stati macellati 10 maiali del genotipo (grande yorkshire, ♀ x landrace tedesco, ♂) x durok, ♂ (GYxLT)xD e 10 maiali del genotipo landrace svedese, ♀ x grande yorkshire, ♂ (LSxGY), le cui cosce sono state preparate secondo la tradizione istriana, supponendo che i prosciutti del genotipo (GYxLT)xD avranno una percentuale maggiore dei grassi intramuscolari, che alla fin fine avrà un effetto positivo sulla qualità del prosciutto in totale. Le analisi hanno dimostrato come segue: una percentuale maggiore della sostanza secca (il 63,00% vs. il 57,86%) e una percentuale minore dell'acqua (il 37,00% vs. il 42,14%) è stato determinato nel prosciutto del genotipo (GYxLT)xD rispetto al genotipo LSxGY (P<0,001), mentre la percentuale delle proteine nei prosciutti di due genotipi non era statisticamente differente; la percentuale dei grassi nei prosciutti (GYxLT)xD era statisticamente notevolmente più grande (il 16,12% vs. l'11,76%) che nei prosciutti LSxGY (P<0,001), mentre la percentuale del NaCl (l'8,29% vs. il 9,04%) era più piccola (P<0,01), la cosa che infatti si aspettava per quanto riguarda la percentuale minore deli grassi nei prosciutti; non è stata determinata una differenza statisticamente importante tra i valori pH dei due genotipi esaminati (il 6,18 vs. il 6,13); contro ciò che si aspettava, il numero di acidità e il numero di perossidi non erano più grandi nei prosciutti del genotipo (GYxLT)xD con la percentuale maggiore dei grasssi. Anzi, tutti e due i parametri erano più grandi nei prosciutti del genotipo LSxGY, però la differenza statisticamente importante (P<0,001) è stata determinata solo per il numero di acidità (il 22,10 mg KOH vs. il 38,50 mg KOH). La conclusione in generale sarebbe che l'uso del durok come una razza terminale nell'allevamento suino, destinato alla produzione di prosciutti, contribuisce alla qualità totale del prosciutto. Questi prosciutti hanno una maggiore percentuale del grasso intramuscolare, che ha un'influenza positiva sulla riduzione della percentuale del sale nel prosciutto, ma la percentuale maggiore dei grassi non aveva un'influenza negativa al grado di grassi acidi che hanno ossidato (il numero di perossidi), e ha influito positivamente sul grado d'idrolisi di acidi grassi (minore numero di acidità).

Parole chiave: *prosciutto istriano, genotipo di maiali, durok, caratteristiche chimiche del prosciutto*

Science of *Food* and *Agriculture* 79, 1280-1284.

Armero, E., M. Flores, F. Toldrá, J.A. Barbosa, J. Olivet, M. Pla, M. Baselga (1999c). Effects of pig sire type and sex on carcass traits, meat quality and sensory quality of dry-cured ham. *Journal* of the *Science* of *Food* and *Agriculture* 79, 1147-1154.

Baldini, P., M. Bellatti, G. Camorali, F. Palmia, G. Parolari, M. Reverberi, G. Pezzani, C. Guerrieri, R. Raczynski, P. Rivaldi (1992): Characterization of Italian raw ham by chemical, phisical, microbiological and organoleptic parameters. Industria Conserve 67, 149-159.

Blasco, A., P. Gou, M. Gispert, J. Estany, Q. Soler, A. Diestre, J. Tibau (1994). Comparison of five types of pig crosses. I. Growth and carcass traits. Liverstock Production Science 40, 171-178.

Carrapiso, A.I., C. García (2008). Effect of the Iberian pig line on dry-cured ham characteristics. Meat Science 80, 529-534.

Cilla, I., J. Altarriba, L. Guerrero, M. Gispert, L. Martínez, C. Moreno, J.A. Beltrán, M.D. Guàrdia, A. Diestre, J. Arnau, P. Roncalés (2006). Effect of different Duroc line sires on carcass composition, meat quality and dry-cured ham acceptability. Meat Science 72, 252-260.

Coutron-Gambotti, C., G. Gandemer (1999). Lipolysis and oxidation in subcutaneous adipose tissue during dry-cured ham processing. Food Chemistry 64, 95-101-

Eakes, B.D., T.N. Blumer, R.J. Monroe (1975). Effect of nitrate and nitrite on color and flavor of country-style hams. Journal of

Food Science 40, 973-976.
Gallo, L., P. Montobbio, P. Carnier, G. Bittange (1994). Breed and crossbreeding affects on weight, yield and quality of heavy Italian dry-cured hams. Liverstock Productin Science 40, 197-205.
Gandemer, G. (2002). Lipids in muscles and adipose tissue, changes during processing and sensory properties of meat products. Meat Science 62, 309-321.
García-Rey, R.M., R. Quiles-Zafra, M.D. Luque de Castro (2006). Relationships of genotype and slaughter time with the appearance and texture of dry-cured hams. Food Chemistry 94, 271-277.
Gou, P., L. Guerrero, J. Arnau (1995). Sex and crossbred effects on the characterictics of dry-cured ham. Meat Science 40, 21-31.
Guerrero, L., P. Gou, P. Alonso, J. Arnau (1996). Study of the phisycochemical and sensorial characteristics of dry-cured hams in three pig genetic types. *Journal* of the *Science* of *Food* and *Agriculture* 70, 526-530.
HRN EN ISO 1443:2002 (2002). Meso i proizvodi od mesa. Određivanje sadržaja ukupne masti.
HRN EN ISO 660:2004 (2004). Životinjske biljne masti i ulja. Određivanje kiselinskog broja i kiselosti.
HRN EN ISO 3960:1999 (1999). Životinjske biljne masti i ulja. Određivanje peroksidnog broja.
James, S.C. (1999). Analytical Chemistry of Foods, Aspen Publishers, Inc. Gaithersburg, Maryland.
Karolyi, D. (2002). Kakvoća buta švedskog landrasa u tehnologiji istarskog pršuta. Magistarski rad. Agronomski fakultet Sveučilišta u Zagrebu.
Krvavica, M. (2003). Utjecaj odsoljavanja na kristalizaciju tirozina i ukupnu kakvoću pršuta. Magistarski rad. Agronomski fakultet Sveučilišta u Zagrebu.
Krvavica, M., J. Đugum (2007). Učinak odsoljavanja na neke fizikalne osobine istarskog pršuta. Meso 1, 32 - 37.
Krvavica, M., S. Vidaček, M. Konjačić, K. Botka-Petrak, T. Petrak, J. Đugum, S. Kolarić, H. Medić (2008): A study of chemical profiles and appearance of white crystals in Istrian dry-cured ham: effect of desalting. Italian Journal of Animal Science 7, 337-382.
Krvavica, M. (2012): Kvalitativne promjene različitih kategorija ovčjeg mesa u procesu salamurenja i sušenja. Doktorski rad. Agronomski fakultet Sveučilišta u Zagrebu.
León-Crespo, F., C. Martins, J.C. Penedo, A. Barranco, C. Mata, F. Beltrán (1986). Diferencias en la composición química de ocho regiones anatómicasdel jamón serrano Ibérico. Alimentaria 23, 23-27.
Oliver, M.A., P. Gou, M. Gispert, A. Diestre, J. Arnau, J.L. Noguera, A. Blasco (1994). Comparison of five types of pig crosses. II fresh meat quality and sensory characteristics of dry-cured ham. Livestock Production Science 40, 179-185.
Peloso, J.V., P.S. Lopes, L.A.M. Gomide, S.E.F. Guimarães, P.L.S. Carneiro (2010). Carcass and ham quality characteristics of heavy pigs from different genetic groups intended for the production of dry.cured hams. Meat Science 86, 371-376.
Rosario Ramírez, M., R. Cava (2007). Effect of Iberian × Duroc genotype on dry-cured loin quality. Meat Science 76, 333-341.
Rosell, C.M., F. Toldrá (1998). Comparison of muscle proteolytic and lipolytic enzyme levels in row hams from Iberian and White pigs. *Journal* of the *Science* of *Food* and *Agriculture* 76, 117-122.
SAS (1999): SAS Version 8. SAS Institute Inc., Cary, NC.
Schivazzapa, C., R. Virgili, M. Degni, C. Cerati (1998). Effects of different pig lines on some characteristics of Parma ham. Industrie Conserve 73, 119-129.
Soriano, A., R. Quiles, C. Mariscal, A. García-Ruiz (2005). Pig sire type and sex effect on carcass traits, meat quality and physicochemical and sensory characteristics of Serrano dry-cured ham. Journal of the Science of Food and Agriculture 85, 1914-1924.
Šimek, J., M. Grolichova, I. Steinhauserová, L. Steinhauser (2004). Carcass and meat quality of selected final hybrids of pigs in the Chez Republic. Meat Science 66, 383-386.
Toldrá, F. (2002). Dry-cured meat products. Food and Nutrition press, inc. Trumbull, Connecticut, USA.
Toldrá, F., M. Flores, J.L. Navarro, M.C. Aristoy, J. Flores (1997). New developments in dry-cured ham. *In* Chemistry of Novel Foods, H. Okai, O. Mills, A.M. Spanier and M. Tamura (eds.), pp. 259-272. Allured Pub. Co., Carol Stream, IL.
Uremović, M., Z. Uremović (1997). Svinjogojstvo. Udžbenik. Agronomski fakultet Sveučilišta u Zagrebu.

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SCIENTIFIC AND PROFESSIONAL SECTION

Food safety and risks

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conference paper

Summary
Food safety relies on early warning identification of dangers and risks. Early warning information regarding microbiological contamination and correlation between food and pathogen is important in a complex system of predicting food infections and intoxications. Reports from disease control centers from different countries give accent on the same microbiological risks as sources of diseases from different food matrices. The most common microbiological contaminants still are: Salmonella spp., Campylobacter spp., Listeria monocytogenes, Escherichia coli, Yersinia enterocolitica. In resolving these issues, we need to emphasize new trends in EU legislation regarding responsibility for production quality and food safety guarantees by the FBOs themselves.
Key words: *food safety, microbiological contamination, risks*

Introduction

By recognizing great dangers in microbiological contamination of food, World Health Assembly and Codex Allimentarius Commission asked for founding of an international expert body by WHO (World Health Organization) and FAO (Food and Agriculture Organization of the United Nations) for the purpose of protecting consumers' health. In that way, WHO and FAO become the founders of the development of health safety approach of risk - based food assessment. The approach has been named generally risk analysis and it consists of a process containing three components: 1. risk assessment; 2. risk management and 3. risk communication.

Basic terms related to risk analysis are **food**, which is defined in accordance with the Food Act (Official Gazette No. 46/07) as every substance which is technologically processed, half processed or raw, intended for consumption, including drinks, chewing gums and other substances used in production, preparation or treatment, but not including cosmetics, tobacco and substances used in terms of drugs. Then, there is **hazard** which is described by a biological, chemical or physical agent or characteristic of food which can have an unfavorable effect on consumer's health. And finally, there is **risk** which is represented by the function of possibility of an unfavorable effect and the size of effect which has a hazard in food as its consequence.

Risk analysis

Risk analysis is a new system which consists of few statements already mentioned. Thereby **risk assessment** is a process based on a scientific assessment of the known and potential unfavorable effects to health which derive from the exposure to hazards from food (CAC, 1999). Due to diversity of possibly harmful factors to organisms, risk analysis developed itself to specific analyses depending on the fact whether causative agents are microbiological or chemical, and there appear even narrower classifications within them. So, different analyses are conducted depending on whether causative agents are viruses, bacteria, parasites, molds, mycotoxins, etc. (BASSET et al., 2012). The same applies to chemical analysis if the causative agents are pesticides, additives and other hazards. Special analyses are conducted for GM food, new food, etc. The methodology of risk analysis is constantly improved, it's becoming narrowly specialized, and many methodologies vary from case to case. The step "monitoring and review", which is the basic aim of food safety, is based on the relation pathogen – food and it should serve the function of prevention, i.e. removing and decreasing risks from food for the purpose of human health protection. Since the politics of food safety should be based on the approach of universality, the responsibility for food safety is put upon producers by implementing the HACCP system, which is a system of good production and hygiene practice, quality system and total quality management (TQM).

Risk management is based on recognition and assessment of efficacy and feasibility and it is concentrated on risk reduction, depending on relative industrial standards.

Risk communication is performed via transparent and consistent informing of the public, by taking into account the creation of trust by the consumers and preventing the feeling of panic (FAO/WHO, 2006; 2007; 2009).

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