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Production of *Napoli* salami from some autochthonous pig genetic types. I. Rheological and colour characteristics[†]

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SUMMARY - The research was carried out on 'Napoli' salami obtained using separable meat, excluding neck and ham, from castrated males and whole females belonging to Calabrese, Cinta senese and Siciliano autochthonous genetic types. The rheological and colour characteristics were evaluated on salami seasoned in two different plants (Angri and Morcone) for 45 d and subsequently stored for 45 and 135 d, partly in a vacuum and partly under kidney fat. The results evidenced that on average: (i) in comparison with Cinta senese, Siciliano provide a more tender salami, with a lower adhesiveness, requiring a lower chewing energy and with a lower red index (a*) (P<0.001); (ii) salami seasoned in Morcone, if compared to that from Angri, is more tender and requires a lower chewing energy (P<0.001); (iii) in comparison with castrated males, females provide a salami characterized by a higher adhesiveness (P<0.05) and hue percentage (P<0.001); and (iv) ranging from 45 d to 135 d of storage, both under vacuum and kidney fat, salami becomes harder and requires a higher chewing energy and has a higher adhesiveness value; furthermore, the reflectance percentage at any considered wavelength, the lightness, yellow and red index as well as hue decrease so that it is "darker" (P<0.001); in addition, salami under vacuum, especially after 135 d, is better than that stored under kidney fat. It is necessary to underline that the rheological and colour characteristics also depend on some interactive effects among the considered factors.

Key words: Pig, autochthonous genetic type, 'Napoli' salami, rheological and colour characteristics.

RESUME - *"La production de Saucisson type* Napoli *avec des porcins de races autochtones. I. Caractéristiques rhéologiques et de couleur". La recherche a été conduite sur le saucisson de type Napoli préparé avec la viande détachée, sauf la 'coppa' et le jambon, de porcins mâles castrés et femelles entières appartenant aux types génétiques autochtones (TGA) Calabrese, Cinta senese et Siciliano. Les caractéristiques rhéologiques et de couleur ont été relevées sur des saucissons mûrs obtenus dans deux établissements différents au bout de 45 jours et conservés pendant 45 jours (90 à partir du moment de la fabrication) et 135 jours (180 à partir du moment de la fabrication), en partie conservés sous vide et sous gras. Les résultats plus importants ont montré qu'en moyenne : (i) le Siciliano donne un saucisson plus tendre, avec une moindre adhésion, et donc moins d'effort de mastication, et un index de rouge inférieur (a*) par rapport à la Cinta senese (*P*<0,001) ; (ii) le saucisson mûri dans l'établissement de Morcone, par rapport à celui de Angri, est plus tendre et demande moins de mastication (*P*<0,001) ; (iii) la femelle, par rapport au mâle castré, donne un saucisson avec une adhésion plus grande (*P*<0,05) et un plus grand pourcentage de couleur (*P*<0,001) ; et (iv) si l'on passe de 45 jours de séchage à 90 jours et à 180 jours de séchage-conservation sous vide ou sous gras, le saucisson devient plus dur et donc la mastication plus difficile et l'index d'adhésion plus grand ; en outre, le pourcentage de réflectance vis-à-vis des différentes longueur d'ondes considérées diminue, ainsi que la luminosité, l'index du rouge et du jaune et la couleur (*P*<0,001), ce qui donne un produit plus 'foncé' ; le saucisson conservé sous vide, surtout celui après 180 jours, présente des caractéristiques meilleures par rapport à celui conservé sous gras. Il est intéressant de préciser que la valeur des caractéristiques rhéologiques et de couleur dépend aussi de certains effets interactifs entre les facteurs considérés.*

Mots-clés : *Porc, types génétiques autochtones, saucisson Napoli, caractéristiques rhéologiques et de couleur.*

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Introduction

The definition of salted pork meat quality by objective methods represent the initial step of a whole evaluation process, while the final phase coincides with the subjective consumer judgement. In particular, the rheological characteristics allow products to be evaluated based on their chewing behaviour (hardness, cohesiveness, springiness, chewiness) (Kramer and Szczesniak, 1973; Matassino *et al.,* 1985), while colour is an index of storage and/or sanity state; indeed this latter is closely linked to the acidification process, during which sodium nitrite changes to nitrogen dioxide, that combining with myoglobin, causes the nitrosomyoglobin production, which is responsible for salami colour (Montemurro *et al.,* 1991).

The aim of this paper is to give a contribution to the knowledge of the effect of genetic type, sex, seasoning-storage time and plants on some rheological and colour characteristics of Napoli salami.

Material and methods

The research was carried out on salami 'Napoli' obtained with separated meat, excluding neck and ham, from castrated males and whole females belonging to Calabrese, Cinta senese and Siciliano autochthonous genetic types. Meat (85%) and belly fat (12%) were triturated using a draw-plate of 12 mm; after homogenization and addition of 2.8% NaCl and 0.2% black peppercorns half ground, half whole, it was sacked in a natural envelope (cattle small intestine) of 50-55 mm diameter. The dripping and drying phases were performed in two cells conditioned for temperature and humidity, situated in two plants: Angri (SA) and Morcone (BN). Subsequently, the salami was transferred to seasoned cell where it remained for 45 d. After this period, the salami was stored half in a vacuum and half under kidney fat for 135 d. Rheological and colour analysis was performed on salami seasoned in the two above cited plants at 45 d of seasoned and at 45 and 135 d of storage.

The statistical analysis was performed by the following variance analysis model, where genetic type (α_i), sex (β_j), plant (γ_k), seasoning-storage time (δ_l) and their relative interactions were considered as fixed and effect of each was expressed as deviation from general average μ:

$$y_{ijklmn} = \mu + \alpha_i + \beta_j + \gamma_k + \delta_l + (\alpha\beta)_{ij} + (\alpha\gamma)_{ik} + (\alpha\delta)_{il} + (\beta\gamma)_{jk} + (\beta\delta)_{jl} + (\gamma\delta)_{kl} + e_{ijklmn}$$

The significance of difference among the estimated means was calculated using Student's t test.

Results and discussion

Data analysis showed that genetic type, plant and seasoning-storage time, as well as interaction between this last factor and the first two statistically influence the rheological and colour characteristics. The statistical model explains from 30% to 40% of total variability for the examined characteristics. Tables 1 and 2 shows that, on average:

(i) In comparison with Cinta senese, Siciliano provide a more tender salami, with a lower adhesiveness, requiring a lower chewing energy and with a lower red index (a*) and saturation colour (chrome) as well as higher hue (P<0.05-0.001); nevertheless, due to 'genetic type x plant' interaction, Siciliano confirms its superiority (lower hardness and chewing energy) compared with Cinta senese for the salami seasoned in Morcone, while achieves better results than Calabrese only for salami from Angri; furthermore, genetic type x seasoning-storage time interaction depends on the fact that the rheologically worse salami is obtained from Calabrese after 45 d of seasoning and from Cinta senese after 45 and 135 d of storing under vacuum.

(ii) In comparison with castrated males, females provide a salami characterized by a higher adhesiveness (P<0.05), red index and hue (P<0.05-0.001).

(iii) Salami seasoned in Morcone, compared to that from Angri, is more tender and requires a lower chewing energy (P<0.001); nevertheless, due to the significant 'plant x seasoning-storage time' interaction, the above cited behaviour occurs only for 45 d seasoned salami, while the contrary exists when salami is stored for 45 and 135 d under kidney fat.

Table 1. Estimated mean value (m) and variation coefficient (cv.,%) of rheological characteristics and significant[†] comparisons between the factor levels

Factor	Rheological characteristics									
	Hardness		Cohesiveness		Springiness		Adhesiveness		Chewiness	
	m	cv. (%)	m	cv. (%)	m	cv. (%)	m	cv. (%)	m	cv. (%)
Genetic type										
Calabrese	5.68^{ac}	38	0.64	13	14.38	10	48.3^{a}	73	5268^{a}	42
Cinta senese	6.35^{a}	60	0.67	14	14.60	13	54.1^{a}	96	5959^{a}	65
Siciliano	5.15^{bc}	45	0.63	16	14.31	6	37.0^{b}	70	4711^{b}	55
Sex										
Castrated male	5.68	51	0.64	14	14.28	9	42.6^{a}	83	5301	59
Whole female	5.78	36	0.63	13	14.58	9	50.3^{b}	75	5324	42
Plants										
Angri	6.22^{a}	55	0.64	14	14.50	11	48.0	79	5815^{a}	59
Morcone	5.23^{b}	37	0.63	15	14.36	6	44.9	82	4810^{b}	46
Seasoning 45 d	3.82^{a}	43	0.56^{a}	11	14.20^{a}	13	20.4^{a}	82	3048^{a}	49
Storing										
Vacuum 45 d	5.95^{b}	47	0.64^{b}	14	14.36^{ab}	5	45.3^{b}	79	5406^{b}	47
Kidney fat 45 d	5.50^{bc}	45	0.64^{bc}	13	14.36^{ab}	6	44.3^{bc}	59	5104^{bc}	49
Vacuum 135 d	6.03^{bd}	36	0.65^{bd}	14	14.72^{b}	6	61.6^{d}	57	5762^{bd}	43
Kidney fat 135 d	7.34^{e}	40	0.68^{e}	10	14.51^{ab}	6	60.6^{e}	74	7244^{e}	45

[†]Different letters within each factor indicate significant level of $P<0.05$

Table 2. Estimated mean value (m) and variation coefficient (cv.,%) of colour characteristics and significant[††] comparisons between the factor levels

Factor	Colour characteristics (Illuminant A)									
	Lightness (L*)		Red index (a*)		Yellow index (b*)		Chrome		Hue	
	m	cv. (%)	m	cv. (%)	m	cv. (%)	m	cv. (%)	m	cv. (%)
Genetic type										
Calabrese	34.0	9	9.6^{ab}	27	4.9	31	10.8^{ab}	27	27.4^{ab}	19
Cinta senese	34.4	9	10.1^{a}	17	5.3	22	11.4^{a}	16	27.4^{b}	15
Siciliano	33.5	10	9.1^{b}	31	4.9	31	10.4^{b}	29	29.1^{c}	18
Sex										
Castrated male	34.1	9	9.3^{a}	27	5.2	29	10.7	26	29.4^{a}	18
Whole female	33.9	11	9.8^{b}	26	4.9	30	11.0	26	26.6^{b}	16
Plants										
Angri	34.3	9	9.8	28	5.1	30	11.1	27	27.6	19
Morcone	33.7	10	9.3	25	5.0	29	10.6	25	28.4	17
Seasoning 45 d	36.5^{a}	9	10.9^{a}	29	6.2^{a}	28	12.5^{a}	28	29.7^{ab}	15
Storing										
Vacuum 45 d	33.8^{b}	8	8.9^{b}	24	4.8^{b}	26	10.2^{b}	22	28.4^{b}	19
Kidney fat 45 d	34.5^{bc}	10	8.1^{c}	22	4.8^{b}	26	9.5^{bc}	20	30.6^{ac}	20
Vacuum 135 d	32.5^{d}	8	10.5^{ad}	22	5.0^{b}	26	11.6^{ad}	21	25.4^{d}	18
Kidney fat 135 d	32.6^{de}	9	9.4^{be}	16	4.6	19	10.4^{be}	16	25.9^{d}	10

[†]Different letters within each factor indicate significant level of $P<0.05$

(iv) Ranging from 45 d to 135 d of storage, both under vacuum and kidney fat, salami becomes harder and requires a higher chewing energy and has a higher adhesiveness value; furthermore, the reflectance percentage at any considered wavelength, the lightness, yellow and red index as well as hue decrease so that it is "darker" (P<0.001); in addition, salami under vacuum, especially after 135 d, is better than that stored under kidney fat, because, according to the results of a previous research (Zullo *et al*., 1996), this latter storage method causes a further drying of the product, hence an increase of hardness, cohesiveness and chewing energy value.

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