

# EFFECT OF RIPENING TIME ON SENSORY TRAITS OF OSTRICH SALAMI

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**Abstract** – The aim of this study was to compare two different ripening times (2.5 and 5 months) of slow-fermented Italian-style salami made with ostrich meat and pork lard from the sensory viewpoint. Twenty-seven descriptors, grouped in external appearance, internal appearance, odour, flavor, off-flavours, texture, ripening time and general acceptability, were evaluated. Ripening time affected quite all sensory descriptors. Shape and casing were improved by the longer ripening time but, probably due to a larger presence of mould, the external acceptability was higher in 2.5 months ripened salami (11.2 vs 9.1). The longer ripening improved significantly ( $P<0.001$ ) the salami colour homogeneity and cohesiveness, reduced gamy odour and odour intensity, increased salty, fatness and mouldy flavour perception, but reduced the gamy flavour ( $P<0.05$ ). The overall salami acceptability didn't change with the ripening time but panelists judged too fresh the salami of both ripening times. Seems likely that this perception was related to the too high pork fat inclusion used, as revealed with the PCA where ripening time and fat inclusion were negatively correlated. Overall results suggested that ostrich meat could be suitable for the production of long-ripened Italian-style salami.

**Key Words** – ostrich, fermented salami, sensory evaluation.

## I. INTRODUCTION

Ostrich meat is characterized by a high nutritional and dietetic value. It is high in polyunsaturated fatty acids –PUFA- (30 to 45% of total FAME), protein (on average 21%) and iron (on average 2.8 mg/100 g), and it is low in cholesterol (on average 63 mg/100 g) contents (personal communication). Notwithstanding, the ostrich meat consumption is not widely diffused out of the Countries of breeding. A way to increase the availability and the diversification of ostrich meat products for the worldwide consumer could be represented by

the production of slow-fermented and dry-cured sausages, such as the so-called Italian salami. It was demonstrated that ostrich meat could be successfully used to produce short-ripened dry-cured sausages [1], but no studies were up to now performed considering a long ripening, typical of the Italian salami. Ripening time has a key role on the flavour development [2] but the correct ripening time that satisfies the consumer acceptability has to be established on each product.

The aim of this study was to evaluate the effect of two ripening times (2.5 and 5 months) on sensory traits of Italian-type salami made with ostrich meat. The study aimed also to verify the possibility to produce long-ripened ostrich salami nitrate/nitrite-free, without affecting sensory quality.

## II. MATERIALS AND METHODS

The whole meat of one 2 year-old and 90 kg of live weight male ostrich (Blue neck x African black) was used to prepare 45 salami of mean weight  $615\pm54$  g, each, stuffed into natural casings. Salami contained 35% pork backfat, 2.5% NaCl, 0.1% spices (black pepper, cinnamon, cloves, nutmeg), 3.6% red wine, and commercial starter culture (*Lactobacillus sakei*, *L. curvatus*, *Staphylococcus xylosum*; 1.6 g/kg), but they did not contain additives.

Salami were dried for 5 days with RH ranging from 65 to 85% and temperature starting from 19 °C and decreasing of 1°C/day. Then, the salami were transferred to a ripening chamber with RH between 70-80%; the initial temperature was 14 °C and it decreased of 1°C/day until 12°C (3<sup>rd</sup> day of ripening), afterwards temperature remained constant. The sensory analysis was

performed at 2.5 and at 5 months of ripening on 9 and on 36 salami, respectively.

Six panelists were previously trained to familiarize with the product and the descriptors used. Then, they evaluated all the salami in 5 sessions (9 salami/session). Twenty-seven descriptors, grouped in external appearance, internal appearance, odour, flavor, off-flavours, texture, ripening time and general acceptability, were evaluated. In each session, two slices (2 mm) per salami were given to the panelists, and they used a 15 cm linear non-structured quantitative scale with verbal extremes: “not regular” to “regular” for shape; “not uniformly linked to the salami” to “uniformly linked” for casing; “none” to “high” for external mould; “dislike” to “like” for external and internal acceptability; “dishomogeneous” to “highly homogeneous” for colour homogeneity; “low” to “high” for cohesiveness, fat inclusion, odour intensity, odour and flavour mouldy, odour and flavour rancidity, odour and flavour gamy, odour and flavour spicy, flavour salty, metallic, fatty, flavour persistency, intensity of off-flavours, and juiciness; “not acceptable” to “very acceptable” for general odour acceptability and for overall acceptability; “less tender” to “tender” for tenderness; “too fresh” to “too ripened” for ripening time.

Data were analysed by univariate ANOVA (GLM procedure) using SAS software package [3] with ripening time (2.5 and 5 months) as main factor. A principal component analysis (PCA) was carried out with data obtained from sensory analysis by using the software XLSTAT 2011.4.02.

### III. RESULTS AND DISCUSSION

Ripening time affected all descriptors of the external appearance ( $P<0.001$ ; Table 1). Shape and casing were improved by the longer ripening time but, probably due to a larger presence of mould (2.42 vs 1.56), the general acceptability was higher in 2.5 months ripened salami (11.2 vs 9.1).

Referring to the internal appearance, the longer ripening improved significantly ( $P<0.001$ ) the salami colour homogeneity (12.2 vs 11.1) and cohesiveness (10.3 vs 8.4) but, on overall, the general acceptability didn't change with ripening time (Table 1).

Table 1 Effect of ripening time on salami appearance (A, B:  $P<0.001$ )

	Ripening time (months)		RSD
	2.5	5	
External appearance:			
Shape	11.76 <sup>A</sup>	12.71 <sup>B</sup>	1.68
Casing	11.98 <sup>A</sup>	13.36 <sup>B</sup>	1.66
Mould	1.56 <sup>A</sup>	2.42 <sup>B</sup>	1.56
General acceptability	11.24 <sup>B</sup>	9.14 <sup>A</sup>	2.78
Internal appearance:			
Colour homogeneity	11.09 <sup>A</sup>	12.20 <sup>B</sup>	1.75
Cohesiveness	8.41 <sup>A</sup>	10.30 <sup>B</sup>	2.60
Fat inclusion	10.57	10.29	1.95
General acceptability	10.22	9.59	2.74

As ripening time increased also mouldy odour significantly increased (0.43 vs 1.45, for ripening time 2.5 vs 5 months, respectively;  $P<0.001$ ), but gamy odour and odour intensity significantly decreased, resulting in no differences in the odour general acceptability (Table 2).

Table 2 Effect of ripening time on salami odour (A, B:  $P<0.01$ )

	Ripening time (months)		RSD
	2.5	5	
Odour:			
Intensity	11.05 <sup>A</sup>	10.24 <sup>B</sup>	1.96
Mouldy	0.43 <sup>A</sup>	1.45 <sup>B</sup>	1.30
Rancidity	1.63	1.41	1.80
Gamy	2.97 <sup>B</sup>	1.88 <sup>A</sup>	1.86
Spicy	8.70	7.18	2.11
General acceptability	10.36	9.91	1.99

Some flavour descriptors were also affected by the ripening time (Table 3). Compared to 2.5 months of ripening the ripening time of 5 months significantly increased salty flavour (8.9 vs 10.2;  $P<0.001$ ), fatness (7.0 vs 8.3;  $P<0.001$ ) and mouldy (1.41 vs 2.63;  $P<0.001$ ) perception. As evidenced for the gamy odour, also gamy flavour was reduced by the ripening time ( $P<0.05$ ). Considered that gamy odour and flavour of processed ostrich meat has reported to negatively affect consumer acceptability [4], a prolonged ripening time could be advantageous.

Neither odour nor flavour rancidity were influenced by the ripening time and, both, were detected at very low levels. Considering also that the off-flavours intensity was low in the salami of both ripening times (4.48 vs 4.59 for ripening times 2.5 vs 5, respectively; NS) it could be stated

that the production of long-ripened Italian-type salami with ostrich meat is doable.

Table 3 Effect of ripening time on salami flavour  
(a, b:  $P<0.05$ ; A, B:  $P<0.001$ )

	Ripening time (months)		RSD
	2.5	5	
Flavour:			
Gamy	2.95 <sup>b</sup>	2.33 <sup>a</sup>	1.90
Salty	8.91 <sup>A</sup>	10.16 <sup>B</sup>	2.03
Rancidity	1.28	1.80	1.92
Metallic	3.36	3.55	1.83
Fatness	7.00 <sup>A</sup>	8.34 <sup>B</sup>	2.00
Mouldy	1.41 <sup>A</sup>	2.63 <sup>B</sup>	2.24
Spicy	8.04	8.31	2.00
Flavour persistency	9.91	10.30	1.83
Off flavours:			
Intensity	4.48	4.59	2.75

Longer ripening reduced the salami tenderness significantly (10.4 vs 8.7 for 2.5 vs 5 months of ripening, respectively;  $P<0.001$ ) but, as the values were higher than the mean value of the quantitative scale, the tenderness was in any case satisfactory (Table 4). On the contrary, the values attributed to the ripening time were below the mean values of the quantitative scale (Table 4) indicating that panelists judged too fresh (not ready to eat) the salami of both ripening times. Seems likely that this perception was related to the too high pork fat inclusion used, as revealed with the PCA where ripening time (RipDur) and fat inclusion (Fatincl) were negatively correlated (Figure 1).

Problems associated with the use of poor fat quality in meat products were widely described [5] and also in our study pork backfat (most likely quality than level) represented a critical point for the salami ripening and sensory quality.

Table 4 Effect of ripening time on salami texture and panelist overall acceptability (A, B:  $P<0.001$ )

	Ripening time (months)		RSD
	2.5	5	
Texture:			
Tenderness	10.42 <sup>B</sup>	8.72 <sup>A</sup>	2.06
Juiciness	10.38	9.92	1.85
Ripening time	4.76 <sup>A</sup>	5.74 <sup>B</sup>	1.64
Overall acceptability	9.53	9.07	2.30

PCA was performed to evaluate the relationship among sensory variables (Figure. 1). The first two principal components accounted for 44.45% of

the total variance. The first PC (23.60% of the total variance) was positively loaded by some descriptors of flavour (fatness, spicy and persistency), by the spicy odour, by the texture (tenderness and juiciness) and by the fat inclusion appearance. Moreover, this component was negatively defined by cohesiveness of the slice, by the internal and overall acceptability, by the ripening time and, to a lesser extent, by the gamy odour and flavour.

The second PC (20.85% of the total variance) was positively defined by ripening time, by some descriptors of the appearance (colour homogeneity, internal and external general acceptability, slice cohesiveness) and by the general odour acceptability, whereas odour and flavour rancidity showed negative loadings in this PC.

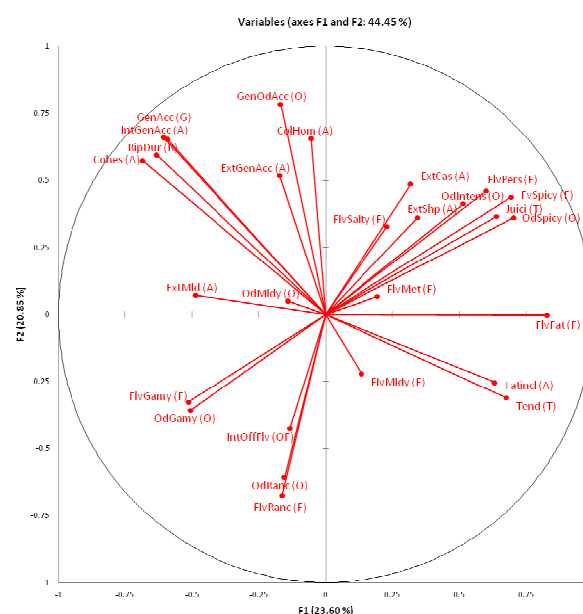


Figure 1. Principal component analysis (PCA) of sensory profiling (A=appearance descriptors, O=odour descriptors, F=flavour descriptors, OF=off-flavour descriptor, T=texture descriptors, R=ripening time descriptor, G=general acceptability descriptor). Parameter loadings plots for the two first principal components (F1 and F2).

Loadings plots (Fig. 1) show that cohesiveness, internal general acceptability, general odour acceptability and overall acceptability were strongly correlated with ripening time (RipDur). In particular, ripening time was positively correlated with overall acceptability ( $r=0.75$ )

indicating that the longer ripening time was appreciated. Flavour persistency was strongly correlated with fat and spicy flavours, with spicy odour, odour intensity and juiciness. Other strong correlations were between gamy odour and gamy flavour ( $r=0.903$ ) and between odour rancidity and flavour rancidity ( $r=0.738$ ). Additionally, PCA found negative relationships between fat inclusion and cohesiveness, internal acceptability, overall acceptability, and ripening time. Finally, gamy odour and flavour were negatively correlated with flavour persistency.

#### IV. CONCLUSION

In conclusion, the results of the present study indicated that some sensory descriptors were negatively affected by the ripening time whereas others were positively affected, but the salami overall acceptability was similar and positive. Pork fat inclusion (level and quality) represented a critical point that needs to be deeply considered to the improvement of the overall salami quality. The Italian-style ripening technology applied for the production of salami made with ostrich meat and pork backfat could offer interesting perspectives for production and application in meat processing.

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