Relationship between the collagen composition and instrumental and sensory texture of Italian cooked meat products prepared with high collagen raw meat

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Abstract— **This study was performed to evaluate the effects of collagen composition on the texture of precooked products, prepared with high connective tissue cuts (such as shoulder muscles, masseters, pig snouts, lard rind, throat rind). Total collagen (TC), hydroxylysylpyridinoline concentration (HLP), index of thermal-stable collagen cross-linking, draining liquid , instrumental texture (TPA) and sensory characteristics were evaluated in sixty precooked products (Zamponi and Cotechini). TPA trials were carried out for each sample with 40% deformation at 70°C. The collagen, that can solubilized (SC) by the difference between the TC and HLP and the relationship between HLP and the TC as index of maturity of the collagen (HLP / TC) have been estimate. No correlations were found between instrumental and sensory texture parameters and draining liquid cooking for TC. Instead, for both the products, a negative linear correlations between HLP and the adhesiveness (R^2 =0.70, p<0.01**) and positive with the instrumental firmness (R^2 =0.75 p<0.01**) are been drawn. The SC positively contributes to the elasticity and to the instrumental cohesion in both the products, even if the correlations are higher for cotechino than for zampone (R^2 =0.73 and p<0.01** R^2 =0.55, p<0.05*respectively). The SC is, besides, positively correlated to the draining liquid as well as to the resistance to the chewing and the graininess with higher correlations for the cotechino. The results indicate that crosslink factor and the correlated parameters can be considered a more important index than TC for cooked meat-based products with high collagen content.**

Keywords— **Collagen crosslinks, cooked meat products, texture.**

I. INTRODUCTION

Collagen plays a most important role in the texture of meat and meat products. The influence of collagen on meat products depends on the degree of comminution and on the extent of gelatinization during cooking [1]. The insoluble and heat-stable crosslinks reduce the collagen solubility, raise conformational transition temperature and increase meat firmness. The composition of collagen in raw meat is affects by several factor (age, dietary, husbandry factors and the type of muscle) [2]. Most of the studies were carry out to evaluate the influence of these factor on the quality of raw meat , while only a few papers are performed on cooked meat products, either whole or minced [3,4].

Otherwise collagen from various sources, is used as ingredients to improve water and fat retention by heating treatment [5,6].

Effects of the type of pork collagen in coarse-grained minced products were evaluated to determine whether plays a role in the observed differences in texture of meat products, prepared traditionally with cuts reach in connective tissue (such as shoulder muscles, masseters, pig snouts, lard rind, throat rind).

II. MATERIALS AND METHODS

This work was carried out on precooked Modena PGI ‘zamponi’ and ‘cotechini’ consumed after heating, provided by the main producers of the sector.

The products packaged in multicoupled bags, were cooked by immersion in boiling water 25’ (cotechini) and 30’ (zamponi) and draining liquid were weighted.

After removing outer casing, the products were minced and then evaluated for proximate analysis, according to AOAC methods [7], instrumental texture (TPA) and sensory characteristics (resistance to chewing and graininess).

A known amount of sample were hydrolysed in 6 N HCl to determine hydroxyproline [7] and crosslink amount, these were determined using a modification of the HPLC procedure developed by Eyre and al. [8]

TPA (texture profiling analysis) trials were carried out for each samples combining two specimen

deformation percentages and two working temperature.

The samples were prepared in the same way as for the sensory analysis and held at 70°C for the duration of the instrumental assessment.

The comparison between proximate composition were performed by ANOVA analysis. Pearson correlations between the texture parameters and collagen factors were estimated with the statistical package SPSS [9].

III. RESULTS

Table 1 shows the proximate composition and the collagen parameters for both type of products; although the variability is high due to the origin of these samples, the collagen is about one third of the total protein. Instead the cross-linking piridinium concentration (HLP) is low respects to the collagen forms that can solubilize with heating.

Table 1 Means, percent standard deviations, minimum and maximus of chemical charachtersics of both the products

Cotechino (n=30)	mean	d.s.r.%	min	max
Moisture (g/100g)	52.42	7.96	45.63	61.21
Fat (g/100g)	21.11	26.73	12.60	31.93
Proteins (g/100g)	22.90	9.08	19.29	27.46
Collagen TC (g/100g)	9.03	18.45	5.20	11.63
TC/proteins	0.39	15.59	0.51	0.22
HLP(g/100g)	1.85	26.79	0.83	2.58
HLP/TC	0.22a	28.61	0.11	0.30
Draining liquid %	29.32	15.77	20.56	37.84

Zampone (n=30)	mean	d.s.r.%	min	max
Moisture (g/100g)	50.39	10.86	41.32	59.88
Fat (g/100g)	23.73	26.97	13.05	33.19
Proteins (g/100g)	22.91	6.65	20.21	24.81
Collagen TC (g/100g	8.88	21.88	6.85	13.84
TC/proteins	0.40	16.54	0.50	0.31
HLP (g/100g)	2.15	14.57	1.71	2.57
HLP/TC	0.28b	20.87	0.21	0.37
Draining liquid %	27.51	15.49	20.55	32.64

a,b: different letters in the same parameter correspond to significant difference ($p<0.05$) among the type of products

The linear correlation reported in Table 2 and Table 3 point out the lack of linear correlations between total collagen and texture and sensorial parameters. The HLP contributes to firmness and the not stable-heat fraction is correlated with elasticity and cohesion and with the sensory resistance to chewing.
The correlation for the cotechino parameter are highter that than zampone

Table 2 Linear correlation between the instrumental and sensorial texture parameters and the collagen factors for cotechini

Cotechino	TC	HLP	HLP/TC	SC
Firmness (N)		0.76**		
MY10 (mJ)				0.45*
Elasticity (mm)				0.73**
Coesion				0.75**
Adhesiveness		-0.72**		
Resistance to the chewing				0.72**
Graininess				0.74**

*significant with $p<0.05$
**** significant with $p<0.01$**

Table 3 Correlation coefficient between the instrumental and sensorial texture parameters and the collagen factors for Zamponi

Zampone	TC	HLP	HLP/TC	SC
Firmness (N)		0.68**		
MY10 (mJ)				
Elasticity				0.65**
Coesion				0.55**
Adhesiveness		-0.75**		
Resistance to the chewing				0.40*
Graininess				0.40*

*significant with $p<0.05$
** significant with $p<0.01$

IV. DISCUSSION

Since every supplier prepared both the products with the same mixture, the differences between the averages and the significant difference ($p<0.05$) obtained by the ratio HLP and TC, as well as changes in correlations between the parameters reported in

table 2 and /or 3, are probably affected by the different permeability of the outer casing, skin of the anterior leg for zampone, gut for cotechino.

As reported from different researchers [1], during the heating of the meat system, when were achieved 65°C, the soluble collagen begins to solubilised. The properties of gelatine to bind lean and fat [fraction], contribute (with myofibrillar proteins) to form the net structure. So the soluble collagen is one of the parameters affecting the yield and texture. The correlations reported in tables 2 and 3, show that solubilising collagen significatinvly contributes to the instrumental cohesion and the elasticity of these types of products. Instead the adhesiveness is negatively correlated, as is obvious, with HLP.

V. CONCLUSION

Nevertheless the study was conducted on sample obtained randomly from the producers, the fractions of collagen with different properties show correlation with some textural and sensorial properties and could explain some behaviours of the products: adhesiveness, elasticity and cohesion. A deeper investigation is needed to confirm their predictive capacity and indicate that the crosslink factor and the correlated parameters can be considered a more important index than TC for cooked meat-based products with high collagen content.

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