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Original Paper

Consumers' sensory analysis of beef hamburger and tartare

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In the last years, consumers preferences are more likely to purchase processed-meat products instead of single meat cuts. To adapt to the new demand, beef industry needs to study consumers' sensory perception of the newly developed products to ensure their acceptability. This study aimed to examine consumers' perception on sensory characteristics of two commercial processed-meat products (hamburger and tartare) from three different types of meat (Holstein-Italian bull, Charolaise bull, and Charolaise heifer). Sensory consumer test was conducted on a non-trained panel of 64 participants for each product to assess color, texture, odor, tenderness, juiciness, salty taste, flavor and overall satisfaction using a 1 (very low) to 7 (very high) intensity scale. Sensory data of each product was analyzed through a linear mixed model including meat type and order of presentation as fixed effects, and participant and residual as random effects. Chemical composition was determined by standard methods in 9 samples of each product (3 samples/type of meat). For hamburgers, protein ranged from 15.9 to 17.0% and fat from 9.1 to 12.9%. For tartare, protein ranged from 20.1 to 20.3%, and for fat from 3.2 to 5.2%. For hamburger, participants perceived differences (P <0.05) in color, tenderness and juiciness between meat types, being the Charolaise bull the most appreciated (P <0.05). For tartare, panelists reported differences (P <0.05) in color, texture and tenderness, being the Charolaise heifer the most appreciated (P <0.05). Our results suggested that the type of meat used related to the fat content can modify consumers' sensory perception of processed-meat products.

Keywords: bull, heifer, meat quality, processed-meat

1 Introduction

In the last decades, changing lifestyles have led to shifting consumer's preferences to purchase more processed-meat (or partially-prepared) products than fresh meat (Resurreccion, 2004; Grunert, 2006). While the poultry industry has been adapted to the new consumers' demands, beef sector has remained more unchanged, gradually losing its share of the meat market (Resurreccion, 2004). Therefore, the beef industry seeks to develop newly processed or partially-prepared products but understanding consumers' sensory perception of these products is fundamental to ensure their acceptability.

Variation in meat sensory quality depends on a wide range of productive (e.g., breed, sex, age, slaughter weight, and diet) and technological factors (e.g., management, refrigeration and aging time). Campo et al. (1999) and Monsón et al. (2005) have reported a breed effect on quantity of residue after chewing, tenderness, overall odor and acid flavor, and Chambaz et al. (2003) for tenderness and juiciness. Heifers deposit more fat than bulls, and their meat presented better characteristics in terms of eating quality because a greater amount of fat and unsaturated fatty acids in the meat is closely related to a better sensory evaluation (Venkata et al., 2015). Indeed, Bureš and Bartoň (2012) reported leaner carcasses in bulls than heifers, and in a sensory panel, meat from heifers was perceived as more tender and more acceptable. Therefore, the aim of this study was to examine consumers' perception of sensory characteristics of two commercial processed-meat products (hamburger and tartare) from three different types of meat (Holstein-Italian bull, Charolaise bull, and Charolaise heifer) using consumer tests.

2 Materials and methods

Hamburgers and tartare were provided by AZOVE Carni s.r.l. (Ospedaletto Euganeo, Italy), which is an important meat industry in the Veneto Region (North-East Italy), in individual skin packaging and cold stored at 4 °C. Three different types of hamburgers and tartare were

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prepared from different meat types regarding beef breed and sex [(i) Holstein-Italian bull (HIB), (ii) Charolaise bull (CB) and (iii) Charolaise heifer (FH)] following AZOVE Carni s.r.l. internal recipe. All the animals were reared in the associated herds of AZOVE Carni s.r.l.; the HIB were born in Italian commercial dairy farms while the CB and CH were imported from French herds and reared and slaughter in Italy. Information about management practice and feeding condition can be retrieved from Gallo et al. (2014). The hamburgers were obtained from the flank steak and the tartare from the boneless roast.

For chemical composition a total of 9 hamburgers and 9 tartare (3 of each type of meat) were analyzed in the laboratory of the Department of Agronomy, Food, Natural resources, Animals and Environment (DAFNAE) of the University of Padova (Legnaro, Italy). Dry matter was determined at 103 °C for 24 h and ash content was measured gravimetrically by igniting samples in a muffle furnace at 550 °C for 4 h (AOAC, 2000). Protein content and ether extract were determination by Kjeltec 2300 and Soxhlet 255 Foss Tecator (Foss Electric A/S, Hillerød, Denmark), respectively (AOAC, 2000). Physical traits – pH, drip loss and color [lightness (L*), red index (a*), yellow index (b*), saturation index (SI)] – were analyzed according to De Marchi et al. (2009). In hamburgers cooking loss and tenderness was evaluated after cooking the hamburger in a hot water bath (75 °C, 45 min). In tartare, tenderness was measured on the raw product. Color traits were determined using the colorimeter Minolta CM-600d (Konica Minolta, Japan) averaging 5 readings for each hamburger sample, and 3 readings for each tartare sample. Color was measured when the pack was opened.

The consumer test was conducted in the Sensory Analysis Laboratory (AnSen-LAB) of DAFNAE to judge color, texture, odor, tenderness, juiciness, salty taste, flavor and overall acceptability on a 7-point scale from very low (1) to very high (7) intensity. A total of 128 non-trained panelists were recruited from a database of students of the University of Padova in Legnaro (Padova, Italy) after compiling a survey to determine their socio-demographic characteristics and acceptability to consume beef hamburger and tartare. Gender equality was assured (55% female and 45% male), and the average age was 21.34 (standard deviation, 2.10). Panelists were randomly split into 8 groups of 16 panelists each. Hamburger and tartare were tested in 2 consecutive days. One day, 4 groups analyzed the hamburger, and the next day, the other 4 groups evaluated the tartare. In each session (30 min) the methodology was explained to the group before starting. Hamburgers were cooked in a hot water bath (75 °C, 60 min) before each session. All samples were presented to the panel at room temperature. For each product, the order of presentation of the samples was: group 1, HIB-CB-CH; group 2, HIB-CH-CB; group 3, CB-HIB-CH; group 4, CH-CB-HIB. Spring water and unsalted bread were provided to clean their mouths between samples.

Consumer test data was analyzed using the PROC MIXED of SAS ver. 9.4 (SAS Institute Inc., Cary, NC). Each product was analyzed separately considering the type of meat (HIB, CB and CH) and the order of presentation (1 to 4) as fixed effects, and participant and residual as random factors. Multiple comparisons of least squares means were performed for the fixed effects using Bonferroni's test. Differences were considered significant at $P < 0.05$, unless otherwise indicated.

3 Results and discussion

Chemical composition and physical traits within each type of product, were similar among the type of meat used (Table 1). The greatest fat content for CH in tartare could be due to the greater fat deposition of heifers than bulls (Venkata et al., 2015). However, that relation was not observed for hamburgers probably due to a lack of standardization of the trimming process between the different types of meat. The statistical model revealed that for hamburgers the order effect was only significant for the assessment of color, whereas the meat type effect was significant for color, tenderness, juiciness and overall satisfaction. On the other hand, for tartare samples, the order was significant for odor and tenderness, while meat type was significant for color, texture, tenderness and overall satisfaction.

For the hamburgers, color was darker in HIB and CH than in CB hamburger, whereas tenderness, juiciness and overall satisfaction were greater in CB than in HIB and CH ($P < 0.05$; Table 2). The brighter color perceived for the CB is in agreement with the greater L* and lower SI reported in Table 1. For tartare, color and texture of Italian-Holstein differed from Charolaise (CB and CH), whereas tenderness and overall satisfaction differed between bull and heifer meat ($P < 0.05$; Table 2). The greater color score for HIB agreed with the lower L* and greater SI presented in Table 1.

Consumers perceived greater scores for color (darker) and texture (grainier) in meat as worse sensory quality, which suggests the lower suitability of HIB meat to produce tartare. Venkata et al. (2015) have reported that as fat increases, meat brightness does, which could explain the brighter color in CB hamburgers. Also, fat is considered an important contributor to tenderness and juiciness (Venkata et al., 2015) which could explain the greater tenderness, juiciness and overall acceptability of CB for hamburgers and CH for tartare.

Table 1 Chemical composition (dry matter basis) and physical traits of hamburger and tartare for each type of meat[a]

	Hamburger			Tartare		
	HIB	CB	CH	HIB	CB	CH
Chemical composition (%)						
Dry matter	29.7(0.16)	32.3(0.60)	30.3 (0.88)	26.6(0.26)	27.3(0.38)	28.8(0.08)
Protein	17.0(0.47)	15.9(0.33)	16.2 (0.32)	20.1(0.06)	20.3(0.11)	20.3(0.09)
Fat	9.10(0.20)	12.9(0.33)	10.2 (0.97)	3.20(0.08)	3.26(0.16)	5.20(0.06)
Ash	2.00(0.03)	1.99(0.05)	2.07 (0.03)	2.19(0.03)	2.21(0.04)	2.14(0.02)
Physical traits[a]						
Drip l. (%)	1.54(0.12)	1.31(0.16)	1.58(0.21)	1.06(0.01)	0.77(0.01)	1.30(0.01)
TEND ($N.g^{-1}$)	19.6(0.51)	14.9(0.24)	18.9(0.67)	11.4(0.82)	6.70(0.55)	6.50(1.96)
Color						
L*	40.8(0.45)	43.8(0.27)	41.7(1.48)	37.5(0.71)	39.5(0.28)	39.1(0.94)
a*	15.5(0.95)	14.7(0.40)	15.7(0.31)	16.8(0.29)	15.4(0.16)	16.9(0.14)
b*	9.30(1.03)	10.3(0.20)	10.4(0.31)	11.3(0.37)	10.5(0.06)	11.2(0.85)
SI (%)	18.1(1.32)	17.9(038)	18.9(0.08)	20.2(0.01)	18.6(0.16)	20.3(0.59)
CL (%)	32.1(0.10)	29.2(1.20)	32.7(0.10)	n.c.	n.c.	n.c.

[a] HIB – Holstein-Italian bull; CB – Charolaise bull; CH – Charolaise heifer; b TEND – tenderness calculated for hamburger after cooking, and in the raw product for tartare; L* – lightness; a* – red index; b* – yellow index; SI – saturation index; CL – cooking loss. Color traits were calculated when the package was opened. n.d., not calculated
Values are mean (standard deviation)

Table 2 Consumers' test sensory analysis of hamburger

	Hamburger			Tartare		
	HIB	CB	CH	HIB	CB	CH
Color	3.59[a]	2.98[b]	3.39[a]	5.28[a]	4.40[b]	4.67[b]
Texture	3.66	3.62	3.79	4.46[a]	4.08[ab]	3.77[b]
Odor	3.07	3.09	3.14	3.69	3.90	3.92
Tenderness	3.78[b]	4.95[a]	3.78[b]	4.50[b]	4.69[b]	5.87[a]
Juiciness	2.83[b]	4.09[a]	3.38[b]	3.52	3.49	3.78
Salty taste	3.04	3.19	3.10	2.73	2.76	3.12
Flavor	3.50	3.65	3.62	3.44	3.25	3.69
Overall acceptability	3.81[b]	4.71[a]	4.03[b]	3.85[b]	3.77[b]	4.42[a]

[a, b, c] – Values within a row for each product (Hamburger or Tartare) with different superscript letters differ significantly at $P < 0.05$

Consumers' test sensory analysis of hamburger (Table 2): 64 participants and tartare 64 participants for each type of meat (HIB, Holstein-Italian bull; CB, Charolaise bull; CH, Charolaise heifer). Attributes were assessed on a 7-point scale from very low (1) to very high (7) intensity. Values are least squares means.

4 Conclusions

Our results indicated that consumers' sensory perception of processed meat products may differ as a function of the type of meat (breed and sex) used to prepare them. Charolaise bull and heifer were the most appreciated meat for hamburgers and tartare, respectively, and their greatest tenderness and juiciness evidenced a close relation with fat content of the product. However, further investigation is needed to discriminate the breed and sex effect from the fat content and fatty acid profile effect.

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