

Sensory differences between young, middle aged and elderly assessors for beef steak of varying texture

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Abstract – The texture of meat products is a key factor influencing the elderly's meat consumption. The aim of this study was to investigate the effects of varying textures (Tender, Medium & Tough) of steak on the physiochemical & sensory properties in different age cohorts. Three identical steaks (M. longissimus dorsi) of the same breed (Limousine cross) gender & age were aged over different time scales: 2, 14 & 21 days. All samples were standardised using Warner- Bratzler shear force (WBSF). Sensory analysis was conducted using range of cohorts (n=9) aged 18-85 years old (n=353). They were asked to determine liking of tenderness, overall flavour, overall firmness, overall texture & overall acceptability using a hedonic scale (AMSA). All analysis was performed in duplicate. The tender sample was most significantly accepted by all age categories. The elderly cohort (81-85) were able to differentiate the samples for the various attributes and place the samples in order of ranking of toughness. This group has a high standard of dentition. It could be hypothesised that dentition and expendable income dictate familiarity with steak as a food and meat avoidance leads to a lack of sensory acuity.

Key Words – Elderly, Sarcopenia, Sensory.

I. INTRODUCTION

Ireland's population is ageing. The number of 85+ year olds is predicted to rise from 74,000 in 2006 to 356,000 in 2041 in Ireland [1].

The quality of life of this population is a major concern. Chronic diseases are the leading cause of diminished quality of life, disability, and increased costs for health care and long-term care in older adults. In Ireland, over 85% of the elderly population receive regular medications to treat chronic conditions associated with ageing [2]. Protein intakes are seen to decrease in the over 65 age category. This may be due to difficulties experienced with chewing, tearing, masticating & swallowing certain meat products. The

To minimise the effect of muscle wasting and sarcopenia in the elderly, it has been suggested that each meal would contain 25–30g of high quality protein [3]. By improving tenderness consumer's acceptance for muscle foods increase [4] & [5]. There are many studies comparing sensory characteristics between elderly and younger consumers, whereby deterioration in the senses was noted as aging progressed [6], [7] & [8]. To date, most research has focused on the flavour differences in foods as perceived by different age cohorts. Relatively little is known about the effects aging has on texture preference. Our specific task was to determine the influence ageing has on the texture characteristics of beef steak.

II. MATERIALS AND METHODS

Sample Preparation

Steak was purchased from a local supplier (Ballyburden Meats Ltd., Ballincollig, Cork, Ireland). The meat was cut into steak pieces (1cm width).

Cooking

Oven cooking was the method of choice, as it is the most easily replicated method. The steak samples were wrapped in tin foil, labelled and dry cooked at 150° C in a Zanussi convection oven (C. Batassi, Conegliano, Italy) for 20 minutes to an internal temperature of 71° C, as measured by a temperature probe (Testo 110, Lenzkirch, Germany). All test samples were cooked at the same time to insure consistency.

Sensory Evaluation

Sensory analysis was carried out on 353 participants in accordance with the methodology of the American Meat Science Association [9] & [10]. On the basis that they regularly consumed and purchased steak. The cohorts were: 18–24 yrs. (n = 21), 25-34 yrs. (n = 44), 35-44 yrs. (n = 28),

45-54 yrs. (n = 18), 55-64 yrs. (n = 26), 60-65 yrs. (n = 60), 65-70 yrs. (n = 50), 70-75 yrs. (n = 52), 75-80 yrs. (n = 51), 80-85 yrs. (n = 3).

The samples were assigned random three digit codes to maintain the anonymity of the samples. Three samples in duplicate were presented to the panellists. They were placed in random order on white polystyrene labelled plates. Consumers were asked to rinse their mouths with water in between each sample. The panellists were asked to rate the samples on a hedonic scale (AMSA) (1-8) [9] & [10]. The hedonics tested included: Tenderness, overall flavour, overall firmness, overall texture and overall acceptability.

Texture Analysis

TPA was used to determine the texture of the samples instrumentally. Using a Texture Analyser 16 TA-XT2i (Stable Micro Systems, Godalming, U.K). Three individual (10mm x 10mm) cylindrical slices of steak were taken from each sample and duplicate sample. The steak then went under a two cycle compression test using a 25 kg load cell. The samples were compressed using a 35mm diameter cylindrical probe (SMS/35 Compression plate). A cross – head speed of 1.5 mm/s was used. The texture profile descriptors measured included the following: hardness (N), springiness (mm), adhesiveness (N x mm), chewiness (N), resilience (dimensionless) and cohesiveness (dimensionless).

Warner – Bratzler shear force

The steaks were cooked to an internal temperature of 71° C. The Steak was chilled in the refrigerator for four hours to an internal temperature of 2° C before coring. Samples were cored to the same diameter of 1.27 cm. The shearing action was perpendicular to the longitudinal orientation of the muscle fibres. The cores were sheared in the middle of each sample. A load cell of 5 kg was used and a crosshead speed of 20cm/min was observed. The methods of Belew et al 2003 were followed [11].

Data Statistical analysis

The data obtained from the sensory, the instrumental and the compositional trials analysis were analysed using ANOVA – Partial Least Squares Regression (APLSR). Data was processed

using Unscrambler software version 10.3. (CAMO ASA, Trondheim, Norway).

Protein content

Protein was determined using the Kjeldahl method [12].

III. RESULTS AND DISCUSSION

The results of the consumer sensory evaluation are presented in the APLSR plot in Fig. 1 with the corresponding P values of the regression coefficients in Table 1.

The 18-30 year old group disliked significantly the tenderness ($P \leq 0.001$) and firmness ($P \leq 0.01$) of the tough sample. They significantly liked the medium sample for flavour ($P \leq 0.001$), firmness ($P \leq 0.05$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.001$). They also significantly liked the tender sample i.e. the sample hanged for 21 days for tenderness ($P \leq 0.001$), flavour ($P \leq 0.001$), firmness ($P \leq 0.01$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.001$).

The 31-40 year old age group significantly disliked the tough sample for tenderness ($P \leq 0.001$), flavour ($P \leq 0.001$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.001$). This age group significantly accepted the medium sample for flavour ($P \leq 0.001$). They significantly liked the tender sample for tenderness ($P \leq 0.001$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.05$).

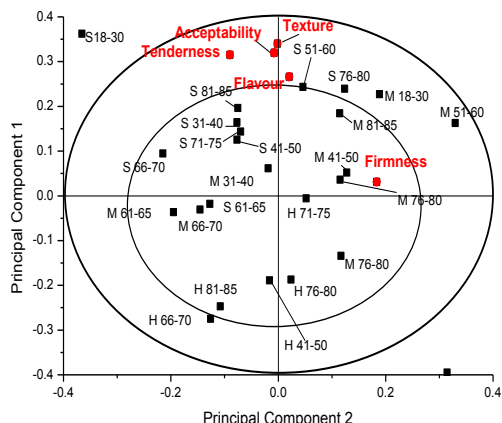
The 41-50 age group significantly disliked the tough sample for tenderness ($P \leq 0.01$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.001$). There were no significant vales observed for the medium sample in this age group. They significantly accepted the tender sample for tenderness ($P \leq 0.01$) and texture ($P \leq 0.01$).

The 51- 60 age group significantly accepted the medium sample for firmness ($P \leq 0.01$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.001$). They also significantly accepted the tender sample for tenderness ($P \leq 0.01$), flavour ($P \leq 0.05$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.001$).

There were no significant values observed for the 61-65 age group. However, there were trends towards a disliking for all attributes of all the samples. The 66-70 age groups were significantly negatively correlated for tenderness ($P \leq 0.05$), flavour ($P \leq 0.001$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.001$) of the tough sample. This

age group was positively significantly correlated for tenderness ($P \leq 0.05$) for the tender sample.

Figure 1: ANOVA - partial least square regression (APLSR) correlation loading plot for each individual sample ($n = 8$).



H = 2 day treatment, M = 14 day treatment, S = 21 day treatment. Age ■ Sensory Attributes ●

Table 1: Average sensory score value V's standard deviation displaying the relationships of sensory terms and various age groups for each sample.

	Tenderness	Flavour	Firmness	Texture	Acceptability
H-18-30	3.44±2.01***	4.43±1.60	5.74±1.56**	3.83±1.82	4.06±1.7
M-18-30	4.35±1.77	4.90±1.63**	5.54±1.42*	4.92±1.69***	4.89±1.54***
S-18-30	5.61±1.58**	5.42±1.74**	4.79±1.21**	5.35±1.67***	5.40±1.56**
H-31-40	2.3±1.59***	2.78±1.91***	6.19±2.1	2.63±2.11***	2.3±1.65***
M-31-40	3.79±1.5	5.10±1.54***	4.93±1.62	4.59±1.72	4.86±1.53
S-31-40	5.07±1.73**	5.07±2.04	5.26±1.32	5.59±1.69***	4.63±1.92*
H-41-50	2.92±1.55**	3.69±1.55	5.08±1.98	2.92±1.32***	2.77±1.36**
M-41-50	4.31±2.17	5.38±1.26	5.84±1.46	4.31±1.25	4.54±1.61
S-41-50	5.61±1.50	4.77±1.64	5.38±0.87	5.38±1.61**	4.92±1.80
M-51-60	4.67±1.53	5.33±1.53	6.67±1.28***	6±0.97**	4.89±1.71***
S-51-60	5.63±2.25**	5.5±1.93*	5.75±1.44	5.88±1.89***	6.13±2.22**
H-61-65	2.94±2.35	3.19±2.43	4.44±3.08	3.38±2.60	3.44±2.53
M-61-65	4.5±2.22	3.69±2.5	4.75±2.01	3.94±1.91	4.31±2.18
S-61-65	4.25±2.46	3.63±2.22	4.94±2.49	4.38±2.42	4.56±2.45
H-66-70	2.72±1.96*	2.83±1.69***	4.72±2.52	3.17±2.33***	2.39±1.50***
M-66-70	4.33±1.24	4.11±1.32	4.89±0.90	4.33±1.28	3.89±1.23
S-66-70	5.67±2.38*	4.72±1.45	4.94±1.98	4.67±2.09	4.5±2.07
H-71-75	3.36±2.29	3.91±2.17	5.36±2.50	4.82±1.94	4.91±2.34
M-71-75	4.18±2.27	4.54±1.91	5.91±1.95	4.63±2.01	4.91±2.89
S-71-75	4.82±1.47	5.45±1.13**	4.91±1.64	5.45±1.57	5.82±1.89*
H-76-80	2.84±2.31	2.61±1.85*	5.38±2.33	3.54±2.63	3.15±2.73
M-76-80	3.15±1.82	3.77±2.17	5.77±1.64	3.85±1.68	2.92±1.80
S-76-80	6.07±1.33***	5.21±1.42*	6.5±0.85*	5.43±1.55***	6.07±1.38***
H-81-85	3.43±2.77*	3.71±2.33*	4.93±2.34	2.5±2.03***	1.5±0.76**
M-81-85	5.57±0.64***	4.36±2.1	6.29±1.68**	6.29±1.27***	5.64±1.82**
S-81-85	5.86±2.38*	5.36±2.68	5.36±1.86	6±1.84*	5.21±2.61

Significance of regression coefficients * = $P \leq 0.05$, * = $P \leq 0.01$, *** = $P \leq 0.001$. - Dictates weather the correlation is negatively correlated. H = 2 day treatment, M = 14 day treatment, S = 21 day treatment.

The 71-75 age group was significantly positively correlated for flavour ($P \leq 0.01$) and the acceptability ($P \leq 0.05$) of the tender sample. The 76 to 80 age group showed negative significances towards the flavour attribute of the tough sample ($P \leq 0.05$). In the tender group they were positively correlated for tenderness ($P \leq 0.001$), flavour ($P \leq 0.05$), firmness ($P \leq 0.05$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.001$). The 81-85 year old age group was negatively correlated for the tough sample for tenderness ($P \leq 0.05$), flavour ($P \leq 0.05$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.01$). They were positively correlated for tenderness ($P \leq 0.001$), firmness ($P \leq 0.001$), texture ($P \leq 0.001$) and acceptability ($P \leq 0.01$) for the medium sample. They were also positively correlated for the tenderness ($P \leq 0.05$) and the texture ($P \leq 0.001$) of the tender sample.

IV. CONCLUSION

Overall, all the age categories found the tough sample (aged 2 days) least acceptable except the 71-75 age category which had a trend towards liking the sample. Flavour was the significant attribute with this age category. A positive score for texture might be due to a lack of familiarity due to meat avoidance. However flavour was still important to them. The medium sample (aged 14 days). The 18-40 and the 51-60 age categories found this sample significantly more acceptable. The 41-50 age group had a trend towards liking this sample. However this was non-significant. The 71-75 age group had a trend towards liking this sample. This was also non-significant. The 76-80 age group had a non-significant trend towards this sample. The 18-40, 51-60 and the 81-85 age category were all positively correlated for significantly liking this sample for firmness, texture and acceptability.

The tender sample (aged 21 days) had the lowest WBSF values. This sample was significantly positively correlated for certain attributes in the 18-60 age category. There was a negative trend observed in the 61-65 age category. There were some positive correlations that were significant in the 66-85 age category. Overall, this was the sample most liked by all the age categories. The younger age groups 18-60 liked it for the same attributes as the older age groups (76-85). As

people age texture and tenderness of meat becomes increasing important from a dentition perspective. Thus influencing the elderly's food choices. There seems to be a loss off sensory acuity for assessors over 60 years old, as they tend not to discriminate between the samples for texture, flavour or hedonic attribute. However, the elderly cohort (81-85) differentiated the samples for all attributes and in order of ranking of toughness. Retrospective demographic analysis indicates this group tended to be well cared for, from affluent backgrounds with a high standard of dentition. It appears that dentition and also perhaps expendable income dictate familiarity with steak as a food and meat avoidance leads to a lack of sensory acuity.

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