INFLUENCE OF FREEZING ON TEXTURE OF BROILER POULTRY MEAT

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Abstract

For consumers, tenderness represents an essential sensorial feature for meat taste. The term "tenderness" is often utilised in alternation with the "texture" one. Meat texture is a complex phenomenon, which includes characteristics such as hardness, elasticity, chew ability, cohesion and succulence. Meat texture variations comes from inherently differences between muscular tissues (maintained compact by the structure of contractile proteins from conjunctive tissue), lipids, carbohydrates, as well as due to external factors, such as thermal treatment and manipulation of samples.

Study aimed the evaluation of three storage regimes different by temperature and time, on three anatomic cut regions (breast, upper thighs and lower thighs) gathered from broiler poultry, for characterization of structure through Warner Bratzlers hear force.

By comparison of the obtained means for musculature of the cut regions from poultry carcasses belonging to three experimental batches, were observed the existent minimums, those ones being attributed to meat samples gathered from carcasses of poultry from batch L3, variation interval between 9.05±0.923 and 15.34±1.204 N/cm^2 showing an increased tenderness, which could be associated with proteins' degradation during storage.

Key words: Tenderness, Crystals, Freezing

INTRODUCTION

Perception on texture is associated with mechanical properties, which are strong tied with muscles' structure, its precise and exact measurement being fundamental for variation and checkout studies. Even if structure is a characteristic which by definition could be best evaluated by hedonic analysis, instrumental evaluation of it represents the base for playback of some correlations between sensorial side and mechanical/instrumental one [2]. So, was realised the evaluation of texture of meat samples for poultry from experimental batches through Warner Bratzler share forces [6].

Tenderness of refrigerated meat is dependant of chilling rate, time period and temperature, poultry meat having a high tenderness rate (5.2 / day), which means that 50% from tenderness appears in around 3 hours and 80% in 10 hours[4].During chilling and maturation, tenderness of poultry meat appears rapidly, the maximal value of the parameter being recorded at 24 hours after slaughtering [1].

Poultry meat freezing imply transformation of water contained in muscles, from liquid state into the solid one. Ice crystals formed in meat provoke a breaking of cellular walls, determining a much softer texture at meat defrosting. Therefore, the localization, number and size of ice crystals which are formed could determine the texture of freeze-defrost product. Fast freezing helps in the formation of small ice crystals, while slow freeze will produce big crystals. Forming of big crystals is dangerous to cellular and membrane structures of muscles, their apparition in extra-cellular locations leading to compressing of cellular structure while those ones are increasing their volume [3].

Effects of poultry meat freezing are observable at defrosting, when losses by dropping produce an exudative meat, in comparison with the poultry meat which was

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freeze into slow regime, textural breakdowns being severe [1]. So, maintaining of suitable temperature during storage have the same importance as the freezing itself process. However, generally, fast freezing of meat assures a better texture in comparison with the slow one [7].

MATERIAL AND METHODS

Study had as general aim the evaluation of three storage regimes different by temperature and time, on three anatomic cut regions (breast, upper thighs and lower thighs) gathered from broiler poultry, gathering being effectuated at 24 hours after slaughtering, further samples were subjected to three storage regimes differentially by temperature and time (L_1= -14°C, 30 days; L_2= -16°C, 90days; L_3= -18°C, 120days)till the moment in which texture was measured.

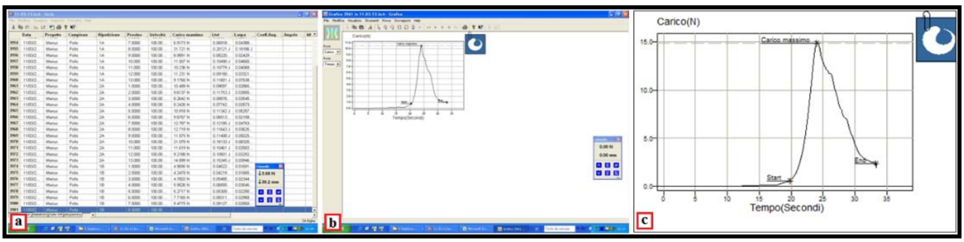

Fig. 1 – Processing data for Warner Bratzler shear force using the Nexygen Ondio software

The utilised working method for determination of meat tenderness through Warner Bratzler shear forces was realised after meat samples were kept for 24 hours at 2–4°C for a slow defrosting, further meat samples were subjected to a thermal treatment on bain-marie for 45 minutes at 75°C (in polyethylene bags),placed on ice for 15 minutes and refrigerated for 45 minutes at 2–4°C. Further chilling time, meat samples were sectioned into a cylindrical shape on muscular fibres way (3 cylinders with ϕ = 15 mm and L = 20 mm) (*fig. 2 a_1, a_2*).

NEXYGEN Ondio software, integrated to Ta Plus Series texture analyzer allowed us a direct calculation of shear forces values function of cutting-deformation curve, those ones being expressed as some peaks*(fig. 1 a,b,c)*, corresponding to maximal recorded value [5], system assuring the function of texture analyzer in according with the demands of *BS EN ISO 7500:1999.*

To determine Warner Bratzler force was utilised a single-blade texture analyzer TA Plus Lloyd Instruments *(fig. 2b),* provided with a specific blade (∢=60°), its velocity being of 100 mm/min in the conditions of a shear force of 1000 N *(fig. 2c_1,c_2,c_3).* Cylindrical meat samples were sectioned perpendicularly of muscular fibres, the maximum force needed for samples' sectioning being the aimed parameter for description of meat tenderness.

For results obtaining, the device is provided with a rigid, rectangular plain surface, sectioned at the median part and with 3 blades with different shapes: a square blade and two blades having the "V" shape.

Significance of differences between the established means for samples gathered from those three experimental batches (L1, L2, L3) was calculated by using the IBM SPSS 20.0 statistic software through T test with two variables (T-Test (2-tailed).

Fig. 2– Meat tenderness determination by using Warner Bratzel shear forces
(**a_1, a_2** – cylindrically shaped cooked meat samples; **b** – determining performance;
c_1, c_2, c_3 – successive stages of the V blade texture meter on the meat sample)

RESULTS AND DISCUSSIONS

Meat tenderness is influenced by many factors, such as exploitation technological system, treatments applied before slaughtering, slaughtering method, manipulation way of cut parts by operators during final processing or by processing at boiling of the resulted meat, the current study evaluating the poultry meat texture by Warner Bratzler shear forces function of storage parameters differentially by temperature and time applied to those three batches *(table 1,2,3).*

Table 1 Breast texture for batches L1, L2, L3 subjected to storage – Warner Bratzler shear force (N/cm^2)

	Indicator	Exp. batch	$\overline{X} \pm s_{\overline{x}}$	V%	Min. – Max.	Interpretation of differences T-Test (2-tailed)	
BREAST	Shear force WB (N/cm^2)	L1	**11.62**±1.517	41.308	5.61 – 17.56	L1-L2	t = -1.406; p = $0.193^{ns.}$
		L2	**15.80**±0.812	16.241	10.50 – 19.64	L1-L3	t = -5.505; p = 0.000^{***}
		L3	**9.05**±0.923	32.256	5.55 – 14.20	L2-L3	t = -2.258; p = 0.050^{*}

T- test (2-tailed)– for analysed character and cut region, comparatively on experimental batches: $^{ns.}$insignificant differences ($p>0.05$);*significant differences ($p<0.05$);***very significant differences ($p<0.001$).

Primary statistical indicators, which characterized the values of WB shear force for meat of poultry from batches L1, L2 and L3 recorded values for standard deviation on mean between interval 0.812–1.517, those ones being correlated with a homogeneity degree inside batch described by interval 15.701–41.308% for L1, 16.241–22.267% at L2 and 24.823–32.256% corresponding to batch L3.

Table 2 Upper thigh texture for batches L1, L2, L3 subjected to storage – Warner Bratzler shear force (N/cm^2)

	Indicator	Exp. batch	$\overline{X} \pm s_{\overline{x}}$	V%	Min. – Max.	Interpretation of differences T-Test (2-tailed)	
UPPER THIGH	Shear force WB (N/cm^2)	L1	**14.99**±0.935	19.734	8.11 – 18.85	L1-L2	t = -0.385; p = 0.709$^{ns.}$
		L2	**18.30**±1.167	20.158	13.64 – 25.61	L1-L3	t =-2.105; p = 0.065$^{ns.}$
		L3	**14.30**±1.232	27.260	8.29 – 19.38	L2-L3	t = -1.840; p = 0.099$^{ns.}$

T- test (2-tailed)– for analysed character and cut region, comparatively on experimental batches: $^{ns.}$insignificant differences (p>0.05);*significant differences (p<0.05);***very significant differences (p<0.001).

By comparing the obtained means for musculature of cut regions from poultry carcasses belonging to those three experimental batches were enlightened the existent minimums, those ones being attributed to meat samples gathered from carcasses of poultry from batch L3, variation interval being between 9.05±0.923 and 15.34±1.204 N/cm^2 indicating an increased tenderness, which could be associated with meat proteins degradation during storage.

From a value point of view, ascendant, the means of shear forces placed intermediary musculature of experimental batch L1 from breast level (11.62±1.517 N/cm^2) and upper thigh (14.99±0.935 N/cm^2), while intermediary mean (16.49±1.161 N/cm^2) of muscular samples gathered from the level of lower thigh were characteristic to batch L2. WB mean shear forces, which characterized the samples' gathered at breast level (15.80±0.812 N/cm^2) and upper thigh (18.30±1.167 N/cm^2) of batch L2, respectively lower thigh (18.29±0.908 N/cm^2) of batch L1 indicated the lowest tenderness inside the respective cut anatomical region.

Table 3 Lower thigh texture for batches L1, L2, L3 subjected to storage – Warner Bratzler shear force (N/cm^2)

	Indicator	Exp. batch	$\overline{X} \pm s_{\overline{x}}$	V%	Min. – Max.	Interpretation of differences T-Test (2-tailed)	
LOWER THIGH	Shear force WB (N/cm^2)	L1	**18.29**±0.908	15.701	13.82 – 22.81	L1-L2	t = -0.581; p = 0.576$^{ns.}$
		L2	**16.49**±1.161	22.267	10.91 – 22.33	L1-L3	t = -2.186; p = 0.057$^{ns.}$
		L3	**15.34**±1.204	24.823	10.19 – 22.72	L2-L3	t = -1.389; p = 0.198$^{ns.}$

T- test (2-tailed)– for analysed character and cut region, comparatively on experimental batches: $^{ns.}$insignificant differences (p>0.05);*significant differences (p<0.05);***very significant differences (p<0.001).

CONCLUSIONS

Meat texture of poultry belonging to experimental batches and stored which was evaluated through Warner Bratzler shear forces varied into interval 9.05–18.29 N/cm^2, the observed minimum described meat gathered from carcasses of poultry belonging to batch L3 inside the same cut anatomical region. In case of pectoral musculature and upper thigh, mend of shear forces placed intermediary musculature of experimental batch L1, followed by the one of batch L2, while at the level of lower thigh, musculature of batch L1 was described by the greatest shear force, followed by the musculature of batches L2 and L3.

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