INFLUENCE OF REFRIGERATION PARAMETERS ON WATER-HOLDING CAPACITY OF POULTRY MEAT

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Abstract

Importance of technological properties derives from needing of provide of some exact information regarding further processing perspective of meat obtained by slaughtering, in conditions of economic efficiency aiming to optimize both product's quality as well as the itself process.

The study had as general aim the evaluation of three refrigeration regimes different by temperature and air current flow, analysing three anatomic cut regions (breast, upper thighs and lower thighs), to characterize the lost in weight through refrigeration.

The values of primary statistical estimators attributed to data which characterized the dispersion degree of the results obtained for weight losses by refrigeration at poultry meat were quite reduced at musculature of the samples from all experimental batches. So, the mean standard error was between limits 0.012–0.052 and calculation of variation coefficient leads to obtaining of values into interval 7.59–24.32%, describing a high homogeneity of character at pectoral musculature and medium to low in case of muscular samples from thighs level for all those three experimental batches, the lack of homogeneity inside experimental batch being attributed to individuality of biological material.

Key words: Water-holding, Refrigeration, Parameter

INTRODUCTION

Water content in meat is correlated with two technological parameters with an economical importance: water-holding capacity (WHC) and water-binding capacity (WBC) (meat capacity for absorption of added water) [5], [2].

The presence of water drops at meat surface is anaesthetic, excessive dropping during refrigeration/commercialization (as a result of evaporation phenomenon from superficial tissues) being a parameter which negatively express both meat quality as well as the economical side of final productivity, choosing of a certain type of meat, with a reduced water-holding capacity or with a greater water-binding capacity depending on the purpose of consumption or processing [6].

Water-holding capacity influence meat tenderness, succulence, firmness and aspect with possible effects for improving meat quality or its economical value. This technological parameter could be externalized as aggregation potential of water, as expressible moisture or effective dropping, each of them having different implications. So, water-binding capacity represents the maximum water quantity which muscular protein could retain [7], [4].

The greatest part of inner-muscular water (between 88–95%) is trapped in intercellular spaces between actin and myosin filaments, only a small part (5–12%) being into the myofibril ones [3].

MATERIAL AND METHODS

The importance of technological properties derives from needing of provide of some exact information regarding further processing perspective of meat obtained by slaughtering, in conditions of economic efficiency aiming to optimize both product's quality as well as the itself process. Ordinary technological evaluation of meat was realised through two important parameters: water-holding capacity and meat water-binding

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capacity, both features being correlated with meat protein nature and of non-protein soluble components [1].

The study aimed to evaluate three refrigeration regimes differentially by temperature and air current flow (L1 = 1°C, 3.5 m/s; L2 = 3°C, 5.5 m/s; L3 = 5°C, 7.5 m/s) on three cut anatomical regions (breast, upper thighs and lower thighs), in order to characterize the weight losses through refrigeration. Meat samples, of around 400 g breast and 100 g upper thigh and lower thigh were packed in polyethylene bags and kept for each batch at the above mentioned parameters for 24 hours, after the initial weight has been established. The losses by refrigeration were expressed as percentage from initial mass of samples (Table 1, 2, 3).

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

RESULTS AND DISCUSSIONS

The samples gathered from poultry carcasses of experimental batches presented a mean value of losses by refrigeration between 0.49±0.012% (pectoral musculature of poultry from batch L1) and 1.12±0.049% (upper thigh musculature of poultry from batch L3), at carcass level, the greatest weight losses being attributed to upper thigh musculature, followed descendant, at small differences by pectoral musculature and the one of lower thigh. As a comparison between batches, the muscular samples gathered from carcasses of poultry belonging to batch L3 presented high weight losses by refrigeration, the minimal values being obtained by meat samples from carcasses of poultry belonging to batch L1 (Table 1, 2, 3).

Table 1 Weight losses of breast function of refrigeration regime

	Exp. batch	Indicator	$\bar{X} \pm s_{\bar{x}}$	V%	Min. – Max.	Interpretation of differences (PGR %) T-Test (2-tailed)	
BREAST	L1	GRT_0 (g)	**448.72**±9.010	6.350	403.76 – 485.72	L1-L2	t = -2.552; p = 0.031*
		GRT_{24} (g)	**446.52**±8.938	6.330	401.83 – 483.15		
		PGR (%)	**0.49**±0.012	7.598	0.44 – 0.55		
	L2	GRT_0 (g)	**451.76**±16.329	11.430	367.36 – 525.54	L1-L3	t = -9.632; p = 0.000***
		GRT_{24} (g)	**449.24**±16.224	11.421	365.16 – 522.22		
		PGR (%)	**0.56**±0.017	9.693	0.46 – 0.63		
	L3	GRT_0 (g)	**450.19**±9.383	6.591	403.76 – 506.87	L2-L3	t = -6.200; p = 0.000***
		GRT_{24} (g)	**446.63**±9.352	6.621	400.55 – 503.22		
		PGR (%)	**0.79**±0.029	11.739	0.64 – 0.93		

R.A.T. = cut anatomical regions; **GRT_0 (g)** = weight of cut anatomical regions at T_0 moment (subsequent to intensive chilling); **GRT_{24} (g)** = weight of cut anatomical regions at T_{24} moment (after 24 h of refrigeration); **PGR (%)** = weight losses during refrigeration; **n** = number of broiler chickens, males "Ross-308"

T - test (2-tailed) – for each cut region and weight losses percentage expressed, in compared on experimental batches: ^{ns} insignificant differences (p>0.05); * significant differences (p<0.05); ** distinct significant differences (p<0.01); *** very significant differences (p<0.001).

Table 2 Weight losses of upper thigh function of refrigeration regime

	Exp. batch	Indicator	$\bar{X} \pm s_{\bar{x}}$	V%	Min. – Max.	Interpretation of differences (PGR %) T-Test (2-tailed)	
UPPER THIGH	L1	GRT_0 (g)	**109.05**±2.172	6.299	97.35 – 117.12	L1-L2	t = -1.803; p = 0.105$^{ns.}$
		GRT_{24} (g)	**108.13**±2.131	6.231	96.63 – 116.13		
		PGR (%)	**0.84**±0.043	16.318	0.60 – 1.05		
	L2	GRT_0 (g)	**109.38**±3.841	11.103	88.58 – 126.72	L1-L3	t = -4.978; p = 0.001***
		GRT_{24} (g)	**108.36**±3.821	11.152	87.80 – 125.70		
		PGR (%)	**0.94**±0.052	17.549	0.76 – 1.20		
	L3	GRT_0 (g)	**109.39**±2.045	5.911	97.15 – 122.22	L2-L3	t = -2.376; p = 0.041*
		GRT_{24} (g)	**108.16**±2.012	5.881	96.23 – 120.74		
		PGR (%)	**1.12**±0.049	13.691	0.82 – 1.33		

R.A.T. = cut anatomical regions; **GRT_0 (g)** = weight of cut anatomical regions at T_0 moment (subsequent to intensive chilling); **GRT_{24} (g)** = weight of cut anatomical regions at T_{24} moment (after 24 h of refrigeration); **PGR (%)** = weight losses during refrigeration; **n** = number of broiler chickens, males "Ross-308"

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Table 3 Weight losses of lower thigh function of refrigeration regime

	Exp. batch	Indicator	$\bar{X} \pm s_{\bar{x}}$	V%	Min. – Max.	Interpretation of differences (PGR %) T-Test (2-tailed)	
LOWER THIGH	L1	GRT_0 (g)	**117.58**±2.692	7.239	101.82 – 127.12	L1-L2	t = -1.667; p = 0.130$^{ns.}$
		GRT_{24} (g)	**116.99**±2.676	7.232	101.36 – 126.49		
		PGR (%)	**0.50**±0.016	10.308	0.44 – 0.61		
	L2	GRT_0 (g)	**119.70**±4.575	12.087	94.30 – 140.98	L1-L3	t = -4.311; p = 0.002**
		GRT_{24} (g)	**119.02**±4.537	12.054	93.91 – 140.26		
		PGR (%)	**0.56**±0.043	24.327	0.42 – 0.84		
	L3	GRT_0 (g)	**143.34**±12.335	27.212	117.80 – 229.40	L2-L3	t = -1.753; p = 0.113$^{ns.}$
		GRT_{24} (g)	**142.38**±12.251	27.211	117.16 – 227.83		
		PGR (%)	**0.68**±0.038	18.028	0.51 – 0.91		

R.A.T. = cut anatomical regions; **GRT_0 (g)** = weight of cut anatomical regions at T_0 moment (subsequent to intensive chilling); **GRT_{24} (g)** = weight of cut anatomical regions at T_{24} moment (after 24 h of refrigeration); **PGR (%)** = weight losses during refrigeration; **n** = number of broiler chickens, males "Ross-308"

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CONCLUSIONS

Weight losses by refrigeration at muscular samples gathered from poultry carcasses from experimental batches presented mean values between 0.49–1.12%; batch L3 presenting increases of weight losses at refrigeration, followed in a descended order by L2 and L1. At carcass level, the highest weight losses were attributed to upper thigh musculature, followed at small differences by pectoral musculature and the one of lower thigh.

REFERENCES

[1] Guárdia D.M., Sárraga C., Guerrero L., 2010 - *Sensory Analysis*, *Handbook of Poultry Science and Technology – Secondary Processing*, vol. 2, cap. 21 pp. 295-308, John Wiley & Sons, Inc. Publisher, USA, ISBN 978-0-470-18553-7.
[2] Lawless H.T., Heymann H., 2010 - *Sensory Evaluation of Food: Principles and Practices*, Springer Publisher Science Business Media, LLC.
[3] Leo M.L., Toldrá N.F., 2009 - *Handbook of Muscle Foods Analysis,* Boca Raton CRC Press.
[4] Leo M.L., Toldrá N.F., 2009 - *Handbook of Processed Meats and Poultry Analysis*, Boca Raton CRC Press.
[5] Petracci M., Bianchi M., Cavani C., 2010 – *Pre-slaughter handling and slaughtering factors influencing poultry product quality*, World's Poultry Science Journal, vol. 66(1), pp. 17-26.
[6] Bianchi M., Petracci M., Sirri F., Folegatti E., Franchini A., Meluzzi A., 2007 - *The influence of the season and market class of broiler chickens on breast meat quality traits*, Poultry Science, vol. 86, pp. 959-963.
[7] Swatland H.J., 1994 - *The conversion of muscle to meat. In Structure and Development of Meat Animals and Poultry*, Technomic Publishing Co., Inc. Lancaster, PA, USA.