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EFFECT OF ELECTRICAL STIMULATION AND AGE OF ANIMALS ON THE QUALITY OF BEEF HAMS PRODUCED FROM *SEMITENDINOSUS* MUSCLE*

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Key words: electrical stimulation, beef hams, instrumental measurement, sensory evaluation

The paper presents results of a research aimed at determining the effect of high-voltage electrical stimulation and age of animals on the major quality attributes of beef hams.

The experimental material consisted of beef meat (*semitendinosus* muscle) originated from heifers aged *ca.* 18 months and from cows aged *ca.* 10 years. Slaughter was performed *ca.* 12 h after resting of animals in lairage. Electrical stimulation of left half-carcasses was performed applying current with the voltage of 330 V, frequency of 17 Hz and pulse duty factor of 0.9, for 120 s. The right half-carcasses were kept as controls. The stimulated meat obtained 24 h after slaughter from the left half-carcasses was used to produce beef hams at the "Ostrołęka S.A." Meat Plant, Ostrołęka. The same technology was applied to produce hams from the non-stimulated meat.

The results obtained indicated, among others, a beneficial effect of applying an own-construction device for electrical stimulation of beef carcasses on improving the quality of hams produced from meat of heifers and cows. Both the instrumental evaluation as well as the final sensory assessment indicated that the electric stimulation applied improved the quality of hams produced from cow meat to a higher extent than the hams produced from the meat of heifers.

INTRODUCTION

The quality of meat and meat products obtained from beef is determined by pre-slaughter factors connected mainly with feeding of animals, pre-slaughter handling of animals (time and conditions of transportation), and *post mortem* treatment involving the application of specific technological procedures. The age and sex of animals to be slaughtered are also of significant importance, as it has been shown that young animals, especially bullocks, are much more susceptible to pre-slaughter stress than old animals. Thus, in order to avoid a drastic drop of glycogen in the muscles upon transportation and staying in lairage, the animals are given a 2% solution of melas, beginning from the producer's cowshed till the lairage [Huff & Parrish, 1993; Dransfield, 1994; Wajda, 1994; Pisula, 1996; Palka & Kołczak, 1998].

Apart from the above-mentioned factors, the quality of meat products obtained from beef is also affected by the type of muscles. It often forms grounds for undertaking the production of a specific type of a product which will fully satisfy the needs and expectations of a consumer [Shorthose *et al.*, 1990; Kołczak , 1992, 2001; Geesink *et al.*, 1995].

Limited possibilities of affecting the quality of meat and its products, resulting from restricted possibilities of human's ingeration at particular stages of pre-slaughter handling, a lack of a sufficient number of slaughter animals, and the necessity of slaughtering old cattle – mainly of cows after lactation period – urge to search for after-slaughter methods of improving the quality of meat. In the last years, electrical stimulation has been serving this purpose well. It is based on the treatment of muscle tissue of carcasses (half-carcasses) with electric current during the first hour after slaughter. The flow of the electric current through the carcass during electrical stimulation evokes contraction of muscles, which in turn results in an accelerated degradation of adenosine triphospahte acid (ATP). In order to compensate ATP consumption, an accelerated degradation of glycogen proceeds. Anaerobic conditions of the process cause the formation of increased amounts of lactic acid, which results in a decrease in pH value of muscle tissue from 0.3 to 0.7 units [Żywica, 1999]. A rapid decline of pH accelerates disruption of lysozymes thus causing the release and increased activity of lysosomal proteolytic enzymes. Those enzymes demonstrate tenderising activity through disruption of inter- and intramolecular bonds of myofibrilar proteins. It results in an increased tenderness of meat subjected to electrical stimulation [Dransfield *et al.*, 1992; Pospiech *et al.*, 1992; Kastner *et al.*, 1993; Gessing *et al.*, 1994; Hwang & Thompson, 2001].

The results of own studies and a lack of conformity of views referring to changes induced by electrical stimulation in beef meat reported in literature incline to undertake an attempt to elucidate partly inconsistent conclusions refer-

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ring to the improvement of the quality of beef meat and its products.

Considering the above and with the use of own-construction high-voltage electrical stimulation device for beef carcasses, a research was undertaken which aimed at determining the influence of high-voltage electrical stimulation on the major quality attributes of beef hams produced from *semitendinosus* muscle under industrial conditions, depending on the age of the animals.

MATERIAL AND METHODS

The experimental material consisted of beef meat (*semitendinosus* muscle). It originated from black-white, lowland breed cattle, namely 8 heifers aged *ca.* 18 months and 8 cows aged *ca.* 10 years, slaughtered *ca.* 12 h after resting in the lairage. After halving, the right half-carcasses were kept as controls, whereas the left half-carcasses were subjected to the high-voltage electrical stimulation applying a current with the voltage of 330 V, frequency of 17 Hz and pulse duty factor of 0.9., for 120 s. The electrical stimulation was conducted with an own-construction device for electrical stimulation of beef carcasses [Żywica *et al.*, 1997]. The device was implemented at the "Ostrołęka S.A." Meat Plant in Ostrołęka, and was awarded the bronze medal at the 45th International Exhibition of Inventions and Innovations "Brussels Eureka 96". After 24-h cold storage, both the stimulated and control half-carcasses were cut into primary cuts and trimmed. From the round of beef obtained from half-carcasses (stimulated and control), *semitendinosus* muscle was dissected, divided into parts and marked: the stimulated parts with [S] and the non-stimulated ones with [K]. The stimulated meat of left half-carcasses was used to produce beef hams at the "Ostrołęka S.A." Meat Plant in Ostrołęka. Similar technological procedure was applied to produce beef hams from the non-stimulated meat.

Measurements of pH values of the *semitendinosus* muscle were performed *ca.* 24 h after stunning with an HI 8314C pH-meter equipped in electrode type FC 200.

Texture evaluation of meat was carried out with a universal testing machine Instron type 4301. Meat samples were rectangular prisms (10×10×30 mm) cut parallel to the orientation of muscle fibres. Shear test was conducted with a universal meat Shear Warner-Bratzler device type 2830-013 (blade angle 60°, knife thickness 1.016 mm) with the knife moving perpendicularly to the orientation of muscle fibres. The following measurements were carried out: the maximum shear force (F_c), displacement at the maximum shear force (D_c), and energy consumption at 50% sample deformation (E_c). The puncture test was performed with a flat plunger (12.6 mm diameter), perpendicularly to the orientation of muscle fibres. A slice of ham (30×30×10 mm) was put onto a metal support plate with a hole (15.3 mm in diameter). The following measurements were made in the experiment: the maximum puncture force (F_p), displacement at the maximum puncture force (D_p), and energy consumption at 50% sample deformation (E_p). The speed of the working part was set at 50 mm/min. The results of the measurements were analysed with a computer using Instron IX Series software, ver. 7.43 [Klettner, 1994; Giese, 1995]. The measurements of the above-mentioned parameters were made in four replications.

The sensory evaluation of hams was performed by six trained panellists. The following attributes were examined: appearance, structure and consistency, taste and flavour. Use was made of a 5-point scale with half scores admissible [PN-A-82007:1996]. Apart from the attributes enumerated in the Polish Norm, an additional evaluation was made for tenderness to get a more explicit picture of the whole subject.

A statistical analysis of the results obtained was carried out on the basis of analysis of variance. Differences between mean values were compared applying Dunkan and Student-Newman-Keuls test (Q-SNK) [SAS Institute Inc., 1991].

RESULTS AND DISCUSSION

The pH measurements of the muscles used to produce hams indicated that the muscles collected from the stimulated half-carcasses were characterised with lower pH values than those collected from the non-stimulated half-carcasses. What is more, higher pH values were reported in the stimulated and non-stimulated muscles of cow half-carcasses, compared to the respective muscles collected from half-carcasses of heifers (Table 1). It confirms the results of our previous studies into the influence of electrical stimulation on the changes in pH values of beef meat, depending on the age of animals [Żywica, 1999]. At the same time, it points to the fact that the meat examined is a fine raw material for the production of beef hams.

The results of the shear test indicated statistically significant ($p \leq 0.05$) differences between the D_c values of the stimulated and control samples of hams produced from the heifer meat. No statistically significant differences were reported neither between the F_c and E_c values of the stimulated samples and the respective values of control samples of hams produced from meat of both heifers and cows nor between the D_c values of the stimulated and control ham samples produced from the meat of cows (Table 2).

The results of the puncture test revealed that statistically significant ($p \leq 0.05$) differences between the F_p values of the stimulated samples and those of the control ones were reported both for hams produced from the meat of heifers and for those produced from the meat of cows. The F_p value

TABLE 1. The results of *semitendinosus* muscle pH measurement 24 h after slaughter.

Experimental group	Heifers, n=8				Cows, n=8			
	S		K		S		K	
	$\bar{x}$	V (%)	$\bar{x}$	V (%)	$\bar{x}$	V (%)	$\bar{x}$	V (%)
pH	5.58	0.84	5.67	0.97	5.72	0.81	5.80	0.93

S – stimulated samples; K – control samples; $\bar{x}$ – average values; V – coefficient of variation; pH – average pH value of the muscle measured *ca.* 24 h from stunning; n – the number of cattle.

TABLE 2. The results of instrumental measurements of beef hams – shear test.

Experimental group	Heifers, n = 8				Cows, n = 8			
	S		K		S		K	
	$\bar{x}$	V (%)	$\bar{x}$	V (%)	$\bar{x}$	V (%)	$\bar{x}$	V (%)
F_c (N)	40.00[a]	15.62	38.00[a]	10.75	52.00[a]	15.44	49.00[a]	14.06
D_c (mm)	18.61[a]	8.16	15.36[b]	7.49	17.72[a]	14.36	19.44[a]	10.10
E_c (J)	0.46[a]	6.83	0.48[a]	8.96	0.56[a]	6.01	0.54[a]	2.95

S – stimulated samples; K – control samples; $\bar{x}$– average values; V – coefficient of variation; F_c – maximum shear force; D_c – displacement at maximum shear force; E_c – energy at 50% deformation, at shear test; a, b – average values of stimulated and control samples, in a specified experimental group, with different superscripts are statistically significantly different ($p \leq 0.05$); n – the number of cattle.

of ham samples originated from the stimulated meat of heifers reached 50 N and was by *ca.* 14% lower than the F_p value of hams produced from the non-stimulated meat of heifers. Whereas the F_p value of hams produced from the stimulated meat of cows accounted for 69 N and was by *ca.* 17% lower than the respective value reported for hams of the non-stimulated cow meat. Statistically significant ($p \leq 0.05$) differences were also observed between the E_p values in the case of hams produced from the stimulated and non-stimulated meat of cows. No statistically significant differences were obtained between the D_p values of ham samples from stimulated meat and the D_p values of ham samples produced from non-stimulated meat of heifers and cows. It is worth emphasising, however, that in the case of both heifers and cows the D_p values of stimulated samples were higher than the respective values of the controls. Statistically significant differences were not reported either between the E_p values of ham samples produced from stimulated meat and the E_p values of ham samples produced from the non-stimulated meat of heifers. A smaller difference (18 N) was observed between the average value of F_p measurements in ham samples originated from the stimulated cow meat and the average value of F_p measurements in hams produced from the stimulated heifer meat, compared to the respective difference (25 N) between the F_p values reported for hams produced from meat not subjected to electrical stimulation (Table 3).

Higher values of D_c and D_p of ham samples produced from the stimulated heifer meat and higher D_p values of ham samples produced from the stimulated cow meat, compared to the respective values obtained for those parameters in hams produced from the non-stimulated meat, point to a higher susceptibility of hams produced from stimulated muscles than those produced from the non-stimulated muscles to plastic deformation. At the same time, they confirm a lower hardness of the hams expressed in lower values of the maximum puncture forces (Table 3).

The results of the sensory evaluation indicated that all the examined attributes of hams produced from the *semitendinosus* muscle collected from the stimulated half--carcasses of heifers and cows obtained higher scores than those of the hams produced from the *semitendinosus* muscle of the non-stimulated half-carcasses. Still, as in the case of the maximum puncture force (puncture test), higher differences between the scores of hams produced from stimulated muscles and those of hams from non-stimulated muscles were obtained in the case of cows. The highest scores (5 points) were noted for structure and consistency as well as for appearance and tenderness (4.92 points) of hams produced from the half-carcasses of stimulated cows (Table 4). Of the evaluated attributes of the stimulated hams, only taste and flavour of heifer meat hams were ranked higher than the taste and flavour of hams produced from the meat of cows. The other attributes obtained higher scores in the case of the stimulated hams produced from cow meat. In addition, substantially higher differences were observed between the results of the sensory evaluation of particular attributes of hams produced from the stimulated meat and the results of the sensory analysis of hams produced from the non-stimulated cow meat, compared to the differences reported between the results of the sensory analysis of the hams produced from the stimulated and non-stimulated meat of heifers (Table 4). The results presented, expressed mainly by considerably lower scores of particular attributes of hams from cow meat than those noted for the hams from non-stimulated heifer meat, confirm literature reports claiming that electrical stimulation enables the production of beef meat with uniform tenderness and that the worse the quality of raw material the higher degree of ready product improvement. Simultaneously they indicate that the electrical stimulation favours the production of high-quality meat products irrespective of the age of animals [Powell, 1991; Dransfield *et al.*, 1992; Żywica *et al.*, 2001].

TABLE 3. The results of instrumental measurements of beef hams – puncture test.

Experimental group	Heifers, n = 8				Cows, n = 8			
	S		K		S		K	
	$\bar{x}$	V (%)	$\bar{x}$	V (%)	$\bar{x}$	V (%)	$\bar{x}$	V (%)
F_p (N)	50.00[a]	14.54	58.00[b]	17.76	69.00[a]	8.29	83.00[b]	13.63
D_p (mm)	8.20[a]	35.86	7.54[a]	31.69	7.59[a]	20.85	7.14[a]	18.41
E_p (J)	0.44[a]	8.24	0.40[a]	23.12	0.65[a]	8.79	0.80[b]	18.58

S – stimulated samples; K – control samples; $\bar{x}$– average values; V – coefficient of variation F_p – maximum puncture force; D_p – displacement at maximum puncture force; E_p – energy at 50% deformation; a, b – average values of stimulated and control samples, in a specified experimental group, with different superscripts are statistically significantly different ($p \leq 0.05$); n – the number of cattle.

TABLE 4. The results of sensory evaluation of beef hams.

Experimental group	Heifers, n = 8				Cows, n = 8			
	S		K		S		K	
	$\bar{x}$	V (%)	$\bar{x}$	V (%)	$\bar{x}$	V (%)	$\bar{x}$	V (%)
Appearance	4.83[a]	8.45	4.58[a]	10.73	4.92[a]	4.15	4.25[b]	16.22
Structure and consistency	4.58[a]	14.50	4.25[a]	17.84	5.00[a]	0.00	4.00[b]	17.68
Tenderness	4.67[a]	17.50	4.17[b]	9.80	4.92[a]	4.15	3.50[b]	15.65
Taste and flavour	4.92[a]	4.15	4.42[b]	11.13	4.75[a]	8.81	3.92[b]	14.92
Final score	**4.75[a]**	**11.61**	**4.35[a]**	**12.43**	**4.90[a]**	**5.20**	**3.92[b]**	**16.69**

S – stimulated samples; K – control samples; $\bar{x}$ – average values; V – coefficient of variation; a, b – average values of stimulated and control samples, in a specified experimental group, with different superscripts are statistically significantly different (p≤0.05); n – the number of cattle.

A higher final score of the hams produced from the muscles of stimulated cow half-carcasses compared to that of the hams from the stimulated heifer muscles results from the application of electrical stimulation and probably from individual traits connected with the age of the animals. Young animals are to a much higher extent susceptible to pre-slaughter stress than the old animals (cows). Hence, keeping of animals in the lairage for *ca.* 12 h was beneficial to the condition of cows and in turn to the quality of hams produced from their meat, whereas it had a negative impact on the condition of heifers increasing their pre-slaughter stress [Wajda, 1994; Pisula, 1996; Żywica, 1999; Wajda, 2001].

On the basis of instrumental analysis (puncture test) and sensory evaluation of the hams produced from the *semitendinosus* muscle of heifers and cows, it can be stated that those evaluations confirm unequivocally that the worst quality was demonstrated by the hams produced from non-stimulated cow half-carcasses. Differences occurred, however, in the instrumental and sensory evaluation referring to the best tenderness. In the instrumental evaluation (puncture test), the lowest hardness and hence the best tenderness were attributed to the hams produced from stimulated heifer meat, whereas in the sensory evaluation – the highest scores for tenderness were reported for the hams from cow meat.

In comparing the evaluation results of the hams produced from the *semitendinosus* muscle collected from the stimulated heifer half-carcasses with those of the hams produced from the semimembranosus muscle [Żywica & Banach, 2001], it should be stated that those hams obtained higher final sensory scores (Table 4) than the hams produced from the *semimembranosus* muscle. It can be concluded then that the higher final scores of those hams result not only from applying the electrical stimulation but also from the type of raw material used for their production.

CONCLUSIONS

1. The results of the instrumental and sensory evaluation proved a beneficial effect of applying an own-construction device for high-voltage electrical stimulation of beef carcasses for the improvement of the quality of hams produced from the meat of heifers and cows. Still a more beneficial influence was observed in the case of the hams produced from cow meat compared to hams originated from heifers.

2. In spite of proving the beneficial effect of electrical stimulation, the lower scores of taste and smell reported for the hams produced from the stimulated cow meat than those of the hams from the stimulated heifer meat (at higher scores of other attributes) as well as low scores of the hams produced from the non-stimulated meat may – in the case of cow hams – negatively affect consumer's evaluation.

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REFERENCES

1. Dransfield E., Wakefield D.K., Parkman I.D., Modelling *post-mortem* tenderisation – I: texture of electrically stimulated and non-stimulated beef. Meat Sci., 1992, 31, 57–73.
2. Dransfield E., Optimalisation of tenderisation, ageing and tenderness. Meat Sci., 1994, 36, 105–121.
3. Geesink G.H., Van Laack R L.J.M., Barnier V.M.H. Smulders F.J.M., Does electrical stimulation affect the speed of ageing or ageing response? Sci. Aliments, 1994, 14, 409–422.
4. Gessink G.H., Koolmees P.A., Van Laack H.I.J.M., Smulders F.J.M., Determinants of tenderisation in beef *Longissimus dorsi* and *Triceps brachii* muscle. Meat Sci., 1995, 41, 7–17.
5. Giese J., Measuring physical properties of foods. Food Technol., 1995, 49, 2, 54–63.
6. Huff E.J., Parrish F.C., Bovine *longissimus* muscle tenderness as affected by *post mortem* aging time, animal age and sex. J. Food Sci., 1993, 58, 713–716.
7. Hwang I.H., Thompson J.M., The effect of time and type of electrical stimulation on the calpain system and meat tenderness in beef *longissimus dorsi* muscle. Meat Sci., 2001, 58, 135–144.
8. Kastner C.L., Schwenke J.R., Kenney P.B., Campbell R.E., Kendall J.A., Miliken G.A., Comparisions of the effect electrical stimulation methods on *post mortem* pH decline in beef muscle. Meat Sci., 1993, 35, 183–190.
9. Kołczak T., Palka K., Zarzycki A., The effect of intermolecular collagen on tenderness and other sensory traits of cattle muscles. Acta Agr. Et Silv. Ser. Zootech., 1992, 30, 75–85 (in Polish).
10. Kołczak T., Łącki J., Obara A., Changes in collagen solubility, tenderness and textures of *m. psoas major* and *m. semitendinosus* during cold storage as influenced cattle age. 2001, *in*: Mat. 47th International Congress of Meat

Science and Technology, 26–31 August 2001, Kraków, Poland, pp. 278–279.
11. Klettner P.G., Fleisch und Fleischerzeugnisse. Messungen der Textur oder Konsistenz mit Prüfmaschinen. Fleischwirtsch., 1994, 74, 4, 378–381.
12. Palka K., Kołczak T., The effect of animal age on thermal drip, tenderness and sensory properies of muscles. Zeszyty Naukowe AR w Krakowie, 1998, 342, 91–98 (in Polish).
13. Pisula A., Basic rules for the production of high-quality culinary beef. Gosp. Mięs., 1996, 48, 2, 42–45 (in Polish).
14. PN-A-82007. Meat products. Cured meat products. 1996 (in Polish).
15. Pospiech E., Dzierżyńska-Cybulko B., Zubielik P., An analysis of glycolytic changes and tenderness of bovine muscles subjected to low-frequency electric stimulation. Roczniki Akademii Rolniczej w Poznaniu, 1992, 223, 75–81 (in Polish).
16. Powell V.H., Quality of beef loin steaks as influenced by animal age, electrical stimulation and ageing. Meat Sci., 1991, 30, 195–205.
17. SAS Institute, Inc. 1991. SAS/STAT Users Guide, Version 6.03. SAS Institute, Inc., Cary, NC.
18. Shorthose W.R., Harris P.V., Effect of animal age on the tenderness of selected beef muscles. J. Food Sci., 1990, 55, 1–8.
19. Wajda S., The effect of pre-slaughter handling of animals on the quality of beef. Abstracts of presentations from "Days of Meat Industry". Warsaw, November 1994, p. 4 (in Polish).
20. Wajda S., Possibility of improving beef meat quality. Gosp. Mięs., 2001, 7, 24–26 (in Polish).
21. Żywica R., Budny J., Pogorzelski M., A system for high-frequency electric stimulation of beef carcasses. Patent RP 173079 B1, 1997 (in Polish).
22. Żywica R., The effect of high-frequency electric stimulation on the course of after-slaughter changes in beef meat determined with selected physicochemical parameters. Acta Acad. Agricult. Tech. Olst., Techn. Aliment., 1999, 580, 12, 35-58 (in Polish).
23. Żywica R., Banach J.K., The effect of electric stimulation and pre-slaughter handling on the quality of beef hams. Biul. Nauk., 2001, 13, 215–221 (in Polish).
24. Żywica R., Kłębukowska L., Budny J., Influence of high voltage electrical stimulation, age and sex on quality of beef hams, 2001, *In*: Mat. 47th International Congress of Meat Science and Technology, 26–31 August 2001, Kraków, Poland, pp. 74–75.

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WPŁYW ELEKTROSTYMULACJI I WIEKU ZWIERZĄT NA JAKOŚĆ SZYNEK WOŁOWYCH WYPRODUKOWANYCH Z MIĘŚNIA PÓŁŚCIĘGNISTEGO

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W pracy przedstawiono wyniki badań mających na celu określenie wpływu elektrostymulacji wysokonapięciowej i wieku zwierząt na podstawowe cechy jakościowe szynek wołowych.

Materiał doświadczalny stanowiło mięso jałówek (mięsień półścięgnisty) w wieku około 18 miesięcy oraz krów w wieku około 10 lat. Uboju dokonano po około 12 godzinach odpoczynku bydła w magazynie żywca. Elektrostymulację lewych półtusz przeprowadzono prądem elektrycznym o napięciu 330 V, częstotliwości 17 Hz i współczynniku wypełnienia 0,9, w czasie 120 sek. Prawe półtusze stanowiły próbę kontrolną. Z mięsa elektrostymulowanego wyprodukowano szynki wołowe w Zakładach Mięsnych Ostrołęka S.A. w Ostrołęce. Podobnie, stosujące tę samą technologię, wyprodukowano szynki z mięsa nie elektrostymulowanego.

Wyniki przeprowadzonych badań wykazały między innymi korzystny wpływ zastosowania własnej konstrukcji urządzenia do wysokonapięciowej elektrostymulacji tusz wołowych na poprawę jakości szynek wyprodukowanych z mięsa jałówek i krów, przy czym zarówno na podstawie oceny instrumentalnej jak i końcowej oceny sensorycznej stwierdzono, że elektrostymualcja w większym stopniu wpłynęła na poprawę jakości szynek wyprodukowanych z mięsa krów niż szynek wyprodukowanych z mięsa jałówek.