CHANGES IN COLLAGEN SOLUBILITY, TENDERNESS AND TEXTURE OF *m. psoas major* AND *m. semitendinosus* DURING COLD STORAGE AS INFLUENCED BY CATTLE AGE

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Background

Beef tenderness depends on many both ante mortem and after slaughter factors (Harper 1999). Amongst them the most important are concentration and properties of intermuscular collagen (Kołczak et al. 1992) as well as changes taking place in intracellular structures during post-mortem ageing. (Palka 2000). Rate of cold storage ageing of muscle with predominant red fibres is slower that than of muscles containing more white fibres (Dransfield 1994). Therefore it can be expected that the rate and scope of changes in beef tenderness and the time of ageing will vary depending on the type of muscles and age of cattle.

Objective

The objective of this study was determination of changes in collagen solubility, tenderness and texture of *m. psoas major* (PM) and *m. semitendinosus* (ST) obtained from calves, heifers and cows carcasses during 12-days cold storage ageing. Changes in collagen solubility in aged muscles after heat treatment were also investigated.

Methods

PM and ST muscles were obtained from left halves of carcasses of aforementioned groups of animals after 24hr past the slaughter. Each of the muscles was divided into 5 parts, which after vacuum packing in foil bags were kept at 4°C for 12 days. Individual samples of muscles were analysed on 1, 3, 6, 9 i 12 day of cold storage respectively. Collagen solubility was measured in heated (at 77°C for 70 min) homogenised muscle slurry prepared with Ringer solution. Shear value and TPA profile was determined for muscle samples roasted at170°C till internal temperature of 78°C using texturemeterTA-XT2 by Stable Micro Systems with Warner-Bratzler attachment and cylindrical barrel of 5 cm diameter. Collagen solubility was also measured in muscles heated in 1 and 12 days after slaughter and after heated muscles were stored at 4°C for 12 days.

Results and discussion

PM and ST muscles of different animal groups varied significantly with regards to all analysed parameters. Raw and heated PM muscle contained less collagen of better solubility in comparison to ST muscle. During cold storage ageing collagen solubility increased and this increase was more intensive in PM muscle than in ST muscle and in muscles of younger animals (Tab.1).

During cold storage of heated muscles took place the significant increase of collagen solubility, this change was most severe for muscles heated after 12 days of cold storage (Tab. 2, 3). Collagen solubility increase was higher in calves' muscles than in heifers' and in heifers' muscles higher than in cows'.

During post-slaughter cold storage ageing an increase in muscle tenderness was higher in ST muscle than in PM muscle (Tab. 4). Tenderisation process was faster in calves' muscles in comparison with heifers' and cows'. Cold storage did not cause any significant changes in such texture parameters as hardness, springiness, cohesiveness and chewiness of analysed muscles. Higher values of texture parameters were obtained for ST muscle. Values of texture parameters for both muscles increased with somatic maturity of cattle.

Conclusions

1. During after-slaughter cold storage ageing of beef solubility of collagen increases; the increase is higher in muscles of younger animals.
2. During cold storage of heated muscles collagen solubility increases and especially in muscles heated after longer cold storage and in muscles of younger animals.
3. During after-slaughter cold storage ageing of beef tenderness of muscles increases, the increase is higher for *m. psoas major* than *m. semitendinosus*.

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Table 1. Soluble collagen concentrations (as % of total collagen) in muscles *m. psoas major* (PM) and *m. semitendinosus* (ST) of calves, heifers and cows, as influenced by cold storage time. Mean values and standard deviations.

Cattle goup	Muscles	Cold storage [days]									
		1		3		6		9		12	
		$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Calves	PM	31,46	6,55	38,09	5,21	39,55	3,69	46,71	2,86	68,18	2,23
	ST	27,81	2,17	28,28	1,38	31,62	2,99	30,69	3,18	39,89	4,49
Heifers	PM	23,66	3,07	20,71	2,10	25,31	1,91	28,61	2,17	38,05	2,30
	ST	13,17	1,19	14,07	1,06	16,48	2,09	25,32	2,18	28,69	4,07
Cows	PM	8,89	1,22	9,93	3,39	12,63	4,68	11,87	3,59	12,95	3,83
	ST	7,44	2,67	8,56	2,93	9,16	2,06	8,64	0,17	12,58	1,06

Table 2. Soluble collagen concentrations (as % of total collagen) in muscles *m. psoas major* (PM) and *m. semitendinosus* (ST) of calves, heifers and cows following heating day after slaughter and 12-days storage. Mean values and standard deviations.

Muscles	Cold storage of heated muscles [days]	Cattle group					
		Calves		Heifers		Cows	
		$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
PM	0	7,67	2,02	6,20	1,09	5,23	1,00
ST		7,97	1,46	4,59	0,87	3,67	1,35
PM	12	14,23	4,46	13,96	2,02	10,51	0,92
ST		10,14	3,21	9,38	0,25	6,46	2,81

Table 3. Soluble collagen concentrations (as % of total collagen) in muscles *m. psoas major* (PM) and *m. semitendinosus* (ST) of calves, heifers and cows following heating 12 days after slaughter and 12-days storage. Mean values and standard deviations.

Muscles	Cold storage of heated muscles [days]	Cattle goup					
		Calves		Heifers		Cows	
		$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
PM	0	22,33	3,13	16,78	2,13	16,29	1,44
ST		17,31	1,33	11,69	1,38	6,43	1,94
PM	12	53,40	1,60	27,89	1,39	24,54	3,68
ST		48,96	7,04	23,80	0,61	17,39	3,22

Table 4. Shear force values (kG/cm^2) of muscles *m. psoas major* (PM) and *m. semitendinosus* (ST) of calves, heifers and cows, as influenced by cold storage time. Mean values and standard deviations.

Cattle group	Muscles	Cold storage [days]									
		1		3		6		9		12	
		$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Calves	PM	3,70	0,26	3,13	0,40	3,06	0,15	2,93	0,25	2,76	0,23
	ST	4,76	0,66	4,23	0,55	3,66	0,30	3,03	0,41	2,90	0,17
Heifers	PM	4,00	0,20	3,69	0,20	3,70	0,51	3,53	0,55	3,40	0,30
	ST	5,70	0,34	4,96	0,55	4,73	0,61	4,50	0,70	4,26	0,60
Cows	PM	4,69	0,20	4,33	0,41	4,23	0,41	4,16	0,55	4,26	0,56
	ST	6,73	0,58	5,93	0,41	5,73	0,57	5,50	0,45	5,26	0,50