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EFFECTS OF WILD BOARS MEAT OF DIFFERENT SEASON OF SHOT ADDITION ON TEXTURE OF FINELY GROUND MODEL PORK AND BEEF SAUSAGES

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ABSTRACT

Meat structure and the effects of wild boars of 40 kg carcass weight shot during spring and winter meat addition on texture, sensory properties and thermal drip of finely ground model meat products manufactured of meat differing in pork and beef meat content were studied. Regardless of season of shot, wild boar meat showed a smaller muscle fibre area and intramuscular fat content and also a thicker peri- and endomysium than the meat from pork shoulder whereas beef was characterized by the thickest muscle fibre and connective tissue. When the season of shot was compared, the highest amount of fat was found in muscles of wild boars shot during autumn and winter than animals from spring and summer. Increasing wild boar meat content resulted in a reduction of hardness and gumminess for beef batter as well as in augmentation of hardness, cohesiveness, springiness and gumminess and reduction of juiciness for pork sausages, irrespectively of kind of wild boar meat addition. Increasing the wild boar of spring and summer meat content resulted in a higher texture and sensory properties changes of model sausages compared to meat from animals shot during autumn and winter. It also resulted in a larger increase of thermal drip in both the pork and beef ground meat products.

Key words: finally ground model sausages, wild boar meat, season of shot, texture, structure

INTRODUCTION

Rational hunting economy deals with not only problems concerning the cultivating principle and criteria of shots of wild animals and also should include some issues related with processing of raw material. These raw materials differ considerably from meat of farm animals and seasonal fluctuations or living conditions, especially food composition within year, have influence on their qualities. Histochemical composition of the wild boar meat differs somewhat from an average histochemical composition of pork and beef, the difference stemming, i.a., from different conditions of life experienced by the wild boar, pigs and cattle [11,18]. Compared to meat from farm animals, wild boar meat is characterized by the low contents of fat (about 7%) and cholesterol and higher amount of proteins (17.1-24.5%), as well as exogenous amino acids, vitamins and unsaturated fatty acids [5,10,11,15,18]. In order to precisely define the nutritious value of wild boar meat, level of collagen is determined and according to different authors amount of collagen is about from 7–10%, relatively to contents of protein and it is considerably higher compared to pork [9, 18]. Therefore, it can be taken advantage in industrial practice for finely ground sausages production because according to Dolata [4] and Rywotycki and Dolata [19] a considerable effects of meat with higher amount of connective tissue on sausages structure and texture has been occurred. Also Lachowicz i Żochowska [13] have ascertained that capability of wild boar meat utilization exists as component influencing on texture of model meat stuffing.

In meat processing, but especially during production of product from game, we deal with raw material of differentiated structure, chemical composition and technological specificity. One may then assume that technological utility of wild boar meat of different season of shot as component influencing on texture will differ.

The study presented here was aimed at comparing the effects of wild boars meat of different season of shot addition on texture and functional properties of finely ground model pork and beef sausages.

MATERIAL AND METHODS

Investigations have been done on sausages produced from both pork and beef TB (*Triceps brachi*) muscles trimmings from the Mas-AR Food Industry and Experimental Production Plant, Agricultural University of Szczecin and wild boar trimmings from one-year old animal (about 40 kg carcass weight) shot during autumn and winter as well as spring and summer in the Western Pomeranian District. A five wild boars of each group were selected to this study.

The TB muscles were cut out of the shoulders and the trimmings were grinding with sieve of 3 mm mesh diameter. Minced meat was salted with curing mixture until a 2,2% weight increase was obtained and kept at the cold room at 4^{o}C for 24 h.

The following batters were prepared:

A. Beef sausages

Wild boar meat addition [%]	Beef addition [%]
0 (control sample)	100
25	75
50	50
75	25
100	0

B. Pork sausages

Wild boar meat addition [%]	Pork addition [%]
0 (control sample)	100
25	75
50	50
75	25
100	0

Meat (about 3 kg) with 20% addition of ice and 10% addition of fat (relatively to mass of meat) were chopping with FGC-E cutter under following conditions:

– 1400 rpm axes speed,
– 12 rpm revolving bowl speed, until the batter was heated to 12ºC. Sausage batters were stuffed in a collagen casings of 20 mm diameter and subjected to cooking in water heated to 75±1ºC, until the temperature inside the sample reached 68±1ºC. The cooked samples were cooled under tap water to about 12ºC and cold stored for 12 h.

Histological assays were made on samples cut from the mid-part of TB (*triceps brachi*) of each groups of animals (wild boar, pig, cattle), three cuts being taken from each type of meat. The samples were dehydrated in alcohol, fixed in the Sannomiya solution, and embedded in paraffin blocks. The blocks were sectioned with a microtome. The sections were placed on slides and contrast-stained with hematoxylin and eosin [3]. The MultiScan computer image analysis software was used to evaluate such structural elements of muscle tissue as fibre cross-sectional area, peri- and endomysium thickness, and an amount of intramuscular fat. The latest structural elements was counted on area of muscle tissue section (about 0.6 cm^2).

Texture assays were made on thermally treated samples of sausages brought to about 18°C. After removal of the plastic sheets, 20 ± 2 mm thick slices were cut by electric knife from each sample to determine their texture on an Instron 1140 apparatus interfaced with a computer. The texture was evaluated using the TPA (double compression) test. The test involved driving a 60 mm diameter shaft twice into a 20 ± 2 mm high sample down to 70% of its height (14 mm). The force-deformation curve obtained served to calculate meat hardness, cohesiveness, springiness, gumminess, and chewiness [2]. The procedure was repeated 12 – 15 times on each sample batch.

Simultaneously to instrumental texture assays the sensory evaluation of the sausages was assessed by a trained expert panel of 4 members with, in general, a minimum of four years experience in texture analysis of meat and meat products. The meat tenderness, juiciness, gumminess and springiness were assessed using a 5-points scale as following – 1 point – the lowest intensity and 5 points – the highest intensity.

Thermal drip loss (%) was calculated from the difference in weight before and after thermal treatment.

RESULTS AND DISSCUSION

Table 1 presents the structural elements of TB muscles of three species – pig, cattle and wild boar. A comparison between structural elements of TB muscles showed the highest mean fibre cross-sectional area and the thickest peri- and endomysium were typical of beef shoulder. The lowest values of connective tissue elements being recorded in pig TB muscles, whereas wild boar muscles consisted of fibres with a lower (by about 32%) cross-sectional areas, and of thicker peri- and endomysium (by about 21 and 10%, respectively) compared to pig muscles. Comparison of intramuscular fat amount showed pig TB muscle to be characterized by the highest and beef by the lowest fat content.

Table 1. Structure of beef, pork and wild boar of different season of shot meat

Meat	Fibre cross-sectional area [μm²]	Perimysium thickness [μm]	Endomysium thickness [μm]	Intramuscular fat content [μm²]
Pork meat	1652.3 ^{b} ±68.7	14.87 ^{a} ±1.87	2.19 ^{a} ±0.07	398410 ^{d} ±2147
Beef meat	2617.3 ^{c} ±81.2	23.9 ^{c} ±2.40	3.78 ^{c} ±0.30	136020 ^{a} ±2964
Wild boar meat: Shot at spring and summer	1167.8 ^{a} ±59.9	19.57 ^{b} ±1.82	2.35 ^{ab} ±0.12	278742 ^{b} ±5473
Shot at autumn and winter	1097.3 ^{a} ±67.1	18.20 ^{ab} ±2.07	2.50 ^{b} ±0.09	336412 ^{c} ±9107

a, b - numbers in columns, marked with identical superscripts are not significantly different within variant of different wild boar meat addition ($p \geq 0.05$).

A higher amount of connective tissue in muscles of wild boar compared to pig meat were observed also by Lachowicz and Żochowska [13], Lachowicz et al. [14] and Korzeniowski et al. [9], whereas Kuhn et al. [12] and Lachowicz et al. [14] reported higher cross-sectional areas or fibre diameters in wild boar than in pig muscles.

When the season of shot was compared (Table 1), wild boars from autumn and winter showed a higher (by about 17%) amount of intramuscular fat compared to animals shot during spring and summer. Those animals showed also an insignificantly lower fibre cross-sectional area, thinner perimysium as well as thicker endomysium.

Difference in the amount of intramuscular fat between wild boar of different season of shot according to Wlazełko and Łabudzki [23] could have been caused by different conditions of existence, especially seasonal availability of high caloric cultivated plant, which amount even over 80% of autumn food of wild boar and effected on higher increase of adipose tissue as well as higher amount of intramuscular fat. On the other hand, a decrease in intramuscular fat content in wild boar muscles at spring according to Stevenson et al. [20], Wiklund et al. [22], Pielowski [16, 17] could be connected with the estrus and thus could be the reason of less intensive feeding and so effected on fat loosing and quality and wild boar meat flavor.

The effect of wild boar meat addition on finely ground pork and beef sausages texture was different (Table 1).
A comparison between textural parameters of **pork sausages** showed the higher wild boar meat addition, regardless of season of shot, effected on a higher values of hardness, cohesiveness, springiness and gumminess. The highest textural parameters changes were observed in sausages made from 75-100% of wild boar meat, compared to control

sample (100% of pork). Those sausages, depending on kind of wild boar meat, showed a higher hardness (by about 13-19%), cohesiveness (by about 5-22%) as well as springiness and gumminess (by about 2-7% and 25-35%, respectively) compared to pork sausages. At the same time, higher textural changes was observed in pork sausages with wild boar meat shot during autumn and winter addition, compared to those made with meat from animals shot during spring and summer.

The effect of wild boar meat addition on textural parameters changes in **beef sausages** was different (Table 2). A comparison between textural parameters of tested sausages showed the decrease in hardness and gumminess together with an increase in wild boar meat addition compared to control samples whereas the cohesiveness and springiness changes were significantly dependent on kind of wild boar meat addition. Sausages produced with meat of animals shot during autumn and winter showed higher springiness, compared to control (100% of beef) and no effects of wild boar meat addition on cohesiveness changes, whereas samples made with addition of wild boar meat shot during spring and summer showed lower cohesiveness and no significant differences in springiness were found.

Table 2. Effect of wild boars meat of different season of shot addition on texture of finely ground model sausages of different pork and beef meat

Wild boar meat addition [%]	Parameter	Pork sausages		Beef sausages	
		wild boars shot during spring and summer	wild boars shot during autumn and winter	wild boars shot during spring and summer	wild boars shot during autumn and winter
	Hardness [N]	$25.19\pm1.20^{a}_{1}$	$25.19\pm1.20^{a}_{1}$	$33.33\pm1.45^{a}_{1}$	$33.33\pm1.45^{b}_{1}$
	Cohesiveness [-]	$0.208\pm0.01^{a}_{1}$	$0.208\pm0.01^{a}_{1}$	$0.265\pm0.02^{c}_{1}$	$0.265\pm0.02^{a}_{1}$
0	Springiness [cm]	$0.91\pm0.04^{a}_{1}$	$0.91\pm0.04^{a}_{1}$	$0.91\pm0.07^{b}_{1}$	$0.91\pm0.07^{a}_{1}$
	Gumminess [N]	$5.16\pm0.47^{a}_{1}$	$5.16\pm0.47^{a}_{1}$	$8.86\pm1.03^{a}_{1}$	$8.86\pm1.03^{a}_{1}$
	Hardness [N]	$27.60\pm3.00^{ab}_{1}$	$26.86\pm1.89^{ab}_{1}$	$32.66\pm1.44^{a}_{1}$	$31.26\pm1.84^{ab}_{1}$
	Cohesiveness [-]	$0.199\pm0.02^{a}_{1}$	$0.205\pm0.03^{a}_{1}$	$0.238\pm0.01^{bc}_{1}$	$0.273\pm0.01^{a}_{2}$
25	Springiness [cm]	$0.92\pm0.02^{a}_{2}$	$0.74\pm0.03^{a}_{1}$	$0.88\pm0.04^{ab}_{1}$	$0.96\pm0.02^{a}_{2}$
	Gumminess [N]	$5.55\pm1.21^{ab}_{1}$	$5.35\pm0.70^{a}_{1}$	$7.77\pm0.41^{a}_{1}$	$8.54\pm0.77^{a}_{1}$
	Hardness [N]	$28.08\pm2.65^{ab}_{1}$	$27.73\pm1.12^{b}_{1}$	$31.96\pm1.82^{a}_{1}$	$31.31\pm4.45^{ab}_{1}$
	Cohesiveness [-]	$0.215\pm0.02^{a}_{1}$	$0.201\pm0.01^{a}_{1}$	$0.210\pm0.01^{a}_{1}$	$0.272\pm0.01^{a}_{2}$
50	Springiness [cm]	$0.92\pm0.05^{a}_{2}$	$0.77\pm0.05^{a}_{1}$	$0.82\pm0.03^{ab}_{1}$	$0.96\pm0.01^{a}_{2}$
	Gumminess [N]	$6.01\pm0.14^{b}_{1}$	$5.57\pm0.46^{a}_{1}$	$6.69\pm0.14^{a}_{1}$	$8.55\pm1.48^{a}_{2}$
	Hardness [N]	$30.21\pm3.06^{b}_{1}$	$29.14\pm1.57^{b}_{1}$	$31.06\pm1.29^{a}_{1}$	$30.83\pm1.77^{ab}_{1}$
	Cohesiveness [-]	$0.218\pm0.02^{a}_{1}$	$0.229\pm0.01^{a}_{1}$	$0.236\pm0.02^{ab}_{1}$	$0.271\pm0.01^{a}_{2}$
75	Springiness [cm]	$0.92\pm0.06^{a}_{2}$	$0.78\pm0.04^{a}_{1}$	$0.78\pm0.05^{a}_{1}$	$0.97\pm0.02^{a}_{2}$
	Gumminess [N]	$6.57\pm0.79^{b}_{1}$	$6.67\pm0.61^{b}_{1}$	$7.32\pm0.57^{a}_{1}$	$8.35\pm0.64^{a}_{1}$
	Hardness [N]	$31.43\pm3.03^{b}_{1}$	$28.99\pm1.28^{b}_{1}$	$31.43\pm3.03^{a}_{1}$	$28.99\pm1.28^{a}_{1}$
	Cohesiveness [-]	$0.219\pm0.04^{a}_{1}$	$0.265\pm0.01^{b}_{2}$	$0.219\pm0.04^{ab}_{1}$	$0.265\pm0.01^{a}_{1}$
100	Springiness [cm]	$0.93\pm0.05^{a}_{1}$	$0.98\pm0.01^{c}_{1}$	$0.93\pm0.05^{b}_{1}$	$0.98\pm0.01^{a}_{1}$
	Gumminess [N]	$6.83\pm0.95^{b}_{1}$	$7.99\pm0.63^{c}_{1}$	$6.83\pm0.95^{a}_{1}$	$7.99\pm0.63^{a}_{1}$

a, b - numbers in columns, marked with identical superscripts are not significantly different within variant of different wild boar meat addition ($p \geq 0.05$).
1, 2 - numbers in columns, marked with identical subscripts are not significantly different among variants with the same addition of wild boar meat ($p \geq 0.05$)

Table 3 presents the values of sensory characteristics of pork and beef sausages according to different addition of wild boar meat of two seasons of shot. The sensory analysis of tested sausages showed pure wild boar product to be characterized by the highest values of sensory characteristics, the lowest were found in beef sausages.

The analysis of sensory properties of **pork sausages** showed, regardless of season of shot, sausages became insignificantly harder, more springy and less juicy and gummy as its wild boar meat addition was higher, however higher hardness and springiness changes were connected with addition of wild boar meat shot during autumn and winter and on the other hand higher juiciness changes was found in sausages produced with addition meat from animals shot during spring and summer.

When the **beef sausages** were compared (Table 3) higher tenderness and springiness as well as lower gumminess were observed together with an increase of wild boar addition – the sensory parameters changes became higher as meat of the wild boar shot during autumn and winters was applied. As observed in this study, the effect of wild boar meat addition on sausage juiciness was different and depending on season of shot – increasing wild boar meat addition from animals shot during spring and summer resulted in a decrease in juiciness and on the other hand meat from wild boars shot during autumn and winter addition effected on an increase in those parameter values.

Table 3. Effect of wild boars meat of different season of shot addition on sensory properties of finely ground sausages of different pork and beef meat

Wild boar meat addition [%]	Parameter	Pork sausages		Beef sausages	
		wild boars shot during spring and summer	wild boars shot during autumn and winter	wild boars shot during spring and summer	wild boars shot during autumn and winter
	Tenderness [pn]	$3.75\pm0.10^{a}_{1}$	$3.75\pm0.10^{b}_{1}$	$3.00\pm0.25^{a}_{1}$	$3.00\pm0.25^{a}_{1}$
	Juiciness [pn]	$4.50\pm0.20^{a}_{1}$	$4.50\pm0.20^{b}_{1}$	$3.75\pm0.10^{b}_{1}$	$3.75\pm0.10^{a}_{1}$
0	Gumminess [pn]	$3.25\pm0.10^{a}_{1}$	$3.25\pm0.10^{b}_{1}$	$3.50\pm0.10^{c}_{1}$	$3.50\pm0.10^{b}_{1}$
	Springiness [pn]	$2.25\pm0.25^{a}_{1}$	$2.25\pm0.25^{a}_{1}$	$2.75\pm0.25^{a}_{1}$	$2.75\pm0.25^{a}_{1}$
	Tenderness [pn]	$3.00\pm0.20^{b}_{1}$	$3.00\pm0.25^{a}_{1}$	$3.25\pm0.10^{a}_{1}$	$3.50\pm0.50^{ab}_{1}$
	Juiciness [pn]	$4.00\pm0.25^{b}_{1}$	$4.50\pm0.25^{ab}_{1}$	$3.50\pm0.20^{b}_{1}$	$3.75\pm0.50^{a}_{1}$
25	Gumminess [pn]	$3.00\pm0.50^{ab}_{1}$	$3.00\pm0.50^{ab}_{1}$	$3.50\pm0.25^{bc}_{1}$	$3.00\pm0.25^{a}_{1}$
	Springiness [pn]	$3.00\pm0.10^{b}_{2}$	$2.75\pm0.10^{b}_{1}$	$3.00\pm0.20^{ab}_{1}$	$3.00\pm0.25^{ab}_{1}$
	Tenderness [pn]	$3.25\pm0.10^{b}_{1}$	$3.25\pm0.20^{a}_{1}$	$3.25\pm0.20^{a}_{1}$	$3.75\pm0.10^{b}_{2}$
	Juiciness [pn]	$4.00\pm0.20^{b}_{1}$	$4.25\pm0.10^{ab}_{1}$	$3.50\pm0.10^{b}_{1}$	$3.50\pm0.25^{a}_{1}$
50	Gumminess [pn]	$3.00\pm0.10^{b}_{1}$	$3.00\pm0.10^{a}_{1}$	$3.25\pm0.10^{b}_{1}$	$3.25\pm0.10^{a}_{1}$
	Springiness [pn]	$3.00\pm0.10^{b}_{1}$	$3.25\pm0.25^{a}_{1}$	$3.00\pm0.10^{ab}_{1}$	$3.50\pm0.25^{bc}_{2}$
	Tenderness [pn]	$3.25\pm0.10^{b}_{1}$	$3.75\pm0.10^{b}_{2}$	$3.50\pm0.50^{ab}_{1}$	$4.25\pm0.10^{c}_{2}$
	Juiciness [pn]	$3.00\pm0.20^{c}_{1}$	$4.25\pm0.10^{ab}_{2}$	$3.75\pm0.25^{b}_{1}$	$3.75\pm0.10^{a}_{1}$
75	Gumminess [pn]	$3.00\pm0.25^{ab}_{1}$	$3.00\pm0.10^{a}_{1}$	$3.50\pm0.10^{c}_{2}$	$3.25\pm0.10^{a}_{1}$
	Springiness [pn]	$3.25\pm0.25^{b}_{1}$	$3.75\pm0.10^{c}_{2}$	$3.25\pm0.20^{bc}_{1}$	$3.75\pm0.10^{c}_{2}$
	Tenderness [pn]	$4.00\pm0.50^{ab}_{1}$	$4.25\pm0.10^{c}_{2}$	$4.00\pm0.50^{b}_{1}$	$4.25\pm0.10^{c}_{1}$
	Juiciness [pn]	$2.50\pm0.10^{d}_{1}$	$4.00\pm0.25^{a}_{2}$	$2.50\pm0.10^{a}_{1}$	$4.00\pm0.25^{a}_{2}$
100	Gumminess [pn]	$3.00\pm0.10^{b}_{1}$	$3.00\pm0.25^{ab}_{1}$	$3.00\pm0.10^{a}_{1}$	$3.00\pm0.25^{a}_{1}$
	Springiness [pn]	$3.25\pm0.10^{b}_{1}$	$3.75\pm0.10^{c}_{2}$	$3.25\pm0.10^{c}_{1}$	$3.75\pm0.10^{c}_{2}$

Notation like in Table 2.

The different effects of wild boar meat addition on texture and sensory properties of pork and beef sausages is probably connected with the structural elements of three kind of meat tested in this study. The decrease in hardness and at the same time increase in tenderness of model beef sausages with the higher wild boar meat addition, regardless of season of shot could be probably connected with the lower muscle fibre cross sectional area, thinner connective tissue and higher amount of intramuscular fat found in wild boar muscle compared to beef [8,9,13,24]. The

higher values of texture parameters of those sausages with the higher wild boar meat addition could be explained higher amount of connective tissue in wild boar meat compared to pork. A similar effect of connective tissue and intramuscular fat addition on sausages texture and sensory properties was reported by Rywotycki and Dolata [19] and Dolata [4]. When the season of shot was compared, one of the reason of higher hardness and lower juiciness of sausages produced with wild boar meat addition from animals shot during spring and summer could be a lower amount of intramuscular fat compared to meat from wild boar shot during autumn and winter [8, 11, 25], which as confirm in this work may be also effected on sensory properties of sausages as well as their acceptance by consumers.

Table 4 presents mean values of thermal drip losses of pork and beef sausages with different amount of wild boar meat addition from animal of two seasons of shot. Among the tested samples, higher (by about 38%) thermal drip losses were shown by beef sausages compared to pork products. Wild boar meat addition effected on higher thermal drip losses, however higher increase in thermal drip was observed when pork sausages with wild boar meat addition were produced. Among the beef sausages, increasing boar meat addition, regardless of season of shot, resulted in an insignificantly higher thermal drip losses (Table 4).

Table 4. Effects of wild boars meat addition on thermal drip of finely ground model sausages of different pork and beef meat

Wild boar meat addition [%]	Thermal drip [%]			
	Pork sausages		Beef sausages	
	wild boars shot during spring and summer	wild boars shot during autumn and winter	wild boars shot during spring and summer	wild boars shot during autumn and winter
0	$11.87\pm1.07\,^{a}_{1}$	$11.87\pm1.07\,^{a}_{1}$	$19.23\pm0.98\,^{a}_{1}$	$19.23\pm0.98\,^{a}_{1}$
25	$14.66\pm1.55\,^{b}_{1}$	$14.06\pm1.15\,^{b}_{1}$	$20.81\pm1.07\,^{ab}_{1}$	$21.14\pm0.86\,^{b}_{1}$
50	$16.49\pm0.75\,^{b}_{1}$	$16.16\pm1.19\,^{b}_{1}$	$22.44\pm0.58\,^{b}_{2}$	$20.77\pm0.97\,^{ab}_{1}$
75	$20.23\pm1.39\,^{c}_{1}$	$19.23\pm1.39\,^{c}_{1}$	$20.82\pm1.30\,^{a}_{1}$	$19.82\pm1.30\,^{ab}_{1}$
100	$20.93\pm1.35\,^{c}_{1}$	$19.75\pm1.03\,^{c}_{1}$	$20.93\pm1.35\,^{ab}_{1}$	$19.75\pm1.03\,^{ab}_{1}$

Notation like in Table 2

Probably, an increase in thermal drip losses with wild boar meat addition, especially for pork sausages, is connected with an increase in soluble collagen content, and as a consequences [1, 5] an increase in connective tissue may cause a higher thermal drip losses and poor water binding capacity.

CONCLUSIONS

1. Regardless of the season of shot, compared to pig muscles those of wild boar showed a lower mean fibre cross-sectional area, a thicker peri- and endomysium, and a lower amount of intramuscular fat, whereas the highest mean cross-sectional area and the thickest peri- and endomysium were typical of beef shoulder.
2. Higher amount of intramuscular fat was recorded in muscles of wild boar shot during autumn and winter compared to those animal shot during spring and summer.
3. Among the tested beef sausages, regardless of kind of wild boar meat addition, the hardness and gumminess decrease were observed, whereas in pork sausages an increase of hardness, cohesiveness, springiness and gumminess as well as a juiciness decrease were found.
4. The addition of meat from wild boar shot during spring and summer was connected with the higher textural and sensory changes compared to meat from those animals shot during autumn and winter.
5. Both in pork and beef sausages, increasing wild boar meat addition resulted generally in a higher thermal drip losses, but especially in the first one.

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Responses to this article, comments are invited and should be submitted within three months of the publication of the article. If accepted for publication, they will be published in the chapter headed 'Discussions' and hyperlinked to the article.
