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SENSORY TRAITS OF CAPON MEAT IN THREE CHICKEN GENOTYPES

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Sensory traits of capon meat in three chicken genotypes

Capons of three genotypes (Barred Prelux, Sulmtaler, Styrian hen) were fattened outdoors and slaughtered at two ages (163 and 198 days). Cockerels were caponised at age 47 days and at age 84 days were moved to grower houses with free access to pasture. Animals had ad libitum access to food and water. Ten carcasses of each genotype and age were sampled at slaughter for sensory analysis. The four trained panellist assessed three traits of raw carcasses on scale 1–5 and 19 traits on roasted carcasses on scale 1–7. Shear force was measured on cooled meat slices by apparatus Texture Analyser, TA.XT plus, Volodkevich contact cell. Statistical analysis was performed by MIXED procedure in SAS/STAT. Age at slaughter affected nine, genotype five and interaction between age and genotype three sensory traits. Shear force differed among genotypes and it got worse at older age. Any of three genotypes was not superior in most of sensory traits. Thus, decision which genotype to fatten and how long depends on preferences and importance of certain sensory traits by consumers.

Key words: poultry / capons / genotype / meat / sensory traits / Slovenia

Senzorične lastnosti mesa kopunov treh genotipov

Kopune treh genotipov (grahasti prelux, sulmtaler, štajerska kokoš) smo pitali v izpustih in zaklali pri dveh starostih (163 in 198 dni). Petelinčke smo kastrirali pri starosti 47 dni in jih pri starosti 84 dni preselili v hlev z izpustom. Živali so imele krmo in vodo po volji. Po deset trupov vsakega genotipa in starosti smo ob zakolu vzorčili za senzorično analizo. Štirje usposobljeni ocenjevalci so na presnih trupih ocenili tri lastnosti (skala 1–5) in na pečenih trupih 19 lastnosti (skala 1–7). Reznost smo merili na ohlajenih rezinah mesa z aparatom Texture Analyser, TA.XT plus, kontaktni nastavek po Volodkevich. Za statistično obdelavo podatkov smo uporabili proceduro MIXED v SAS/STAT. Starost ob zakolu je vplivala na devet, genotip na pet ter interakcija med starostjo in genotipom na tri senzorične lastnosti. Rezna trdnost se je med genotipi razlikovala, povečala pa se je s starostjo. Noben od genotipov ni najboljši v večini senzoričnih lastnosti, zato je odločitev, kateri genotip kopunov bi bil najprimernejši, odvisna predvsem od želja in pomembnosti senoričnih lastnosti s strani porabnikov.

Ključne besede: perutnina / kopuni / genotip / meso / senzorične lastnosti / Slovenija

1 INTRODUCTION

Meat of capons was already in the past appreciated type of meat. The capon meat is known to be tender, juicy and tasty. These characteristics are result of higher content of intramuscular fat as well as greater deposition of subcutaneous fat and in abdominal cavity in capons compared to pullets and cockerels (Cason at al., 1988, Tor *et al.*, 2002). Razingar (1932) wrote that roasted meat of capons is the best and the taste of capon meat surpasses all others. It was known that Napoleon requested roasted capons and especially of our autochthonous breed – Styr-

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ian hen. Nowadays the capon meat is valued in Mediterranean countries, as speciality is acknowledged in France and Italy, as well as in United States (Cvrtila *et al.*, 2007).

Caponisation reduces the plasma testosteron level and stimulates fat accumulation in adipose tissue, in subcutaneous and intramuscular tissue (Cason at al., 1988, Tor *et al.*, 005, Chen *et al.*, 2005), as well as increases blood lipids and changes lipoprotein profile (Chen *et al.*, 2005). Chen *et al.* (2007) showed that hepatic lipogenesis is up-regulated in caponizated birds. The activity of nicotinamide adenine dinucleotide phosphate – malic dehidrogenaze (MDH) is increased, as well as MDH mRNA content is increased in the liver. Consequently, total hepatic lipid and triacylglycerol contents are increased.

The age of animal has an important effect on sensory traits of poultry meat (Remignon and Culioli, 1995, Večerek *et al.*, 2005). Juiciness and tenderness of muscle fibres worsen with age, while the intensity of aroma increases (Remignon and Culioli, 1995). According to literature, recommended age at which caponisation of cockerels should be performed varies as well as optimal age of capons at slaughter (Cason *et al.*, 1988). The optimal age of caponisation and slaughter age of capons are dependent on production type and breed.

In the studies where sensory traits of meat of cockerels and capons were compared, the results showed that capon meat is tenderer than the meat of cockerels (Mast *et al.*, 1981). Garcia *et al.* (1995) depicted no differences in aroma of cooked meat of breast and thigh in capons. Slight differences were assessed in thigh meat, which had less tender muscle fibres and better juiciness as a consequence of higher fat content. Miguel *et al.* (2008) found the capons of Castellana Negra juicier and tenderer than cocks. However, meat of cocks had more flavour and larger amount of conjunctive tissue than capons.

The rearing conditions affect sensory traits of capon meat to a smaller extent. Garcia Martin *et al.* (1995) did not notice any difference in sensory traits of capon meat reared in indoor or outdoor system. However, current consumers in many places prefer meat from animals reared outdoors, although they do not recognise differences in meat sensory traits (Fanatico *et al.*, 2007).

New animal products are researched and rearing systems which are friendly to animals and environment are studied nowadays. The autochthonous and traditional breeds are under preservation schemes as well. Thus, the meat quality of three genotypes of capons reared outdoors was investigated. In the experiment, capons of two autochthonous breeds (Styrian hen and Sulmtaler) and hybrid Barred Prelux (crossbreed between two Slovenian traditional breeds of laying hens) were included. The Styrian hen is autochthonous breed in Slovenia and Austria, while Sulmtaler is autochthonous breed in Austria. The goal of the paper is to present results of sensory analysis of meat of capons slaughtered at two ages.

2 MATERIAL AND METHODS

2.1 ANIMALS, REARING AND SLAUGHTERING CONDITIONS

The experiment started with housing of one day old cockerels of three genotypes: 116 birds of Styrian Hen (a Slovenian autochthonous breed), 117 birds of Barred Prelux (a layer-type Slovenian hybrid), and 107 birds of Sulmtaler (an Austrian breed). After hatching, chickens were sexed and cockerels were individually marked by toe punching and weighed. They were housed in a light tight facility in three separate floor pens. Pens were littered by wood shavings. Cockerels were reared upon standard technology for broilers. Cockerels were caponised at age of 47 days. At age of 84 days, they were moved to separate grower houses with free access to pasture, where all prescribed conditions for free-range rearing were met. At pasture, area of 4 m^2 per bird was provided.

Cockerels were fed *ad libitum* with commercial diets – complete feeding mixture for chickens (21.0% crude proteins, 13.28 MJ ME/kg) for the first 4 weeks. From 5 weeks until the end of experiment, they received complete feeding mixture for pullets (14.8% crude proteins, 11.21 MJ ME/kg). Water for drinking was freely available all the time.

At two ages (163 days and 198 days), random sample of 30 capons per genotype was weighed and slaughtered. Birds were fasted overnight before the slaughter. Carcass measurements were taken on cold carcasses. Ten carcasses of each genotype and age were frozen until assessment of sensory traits.

2.2 SAMPLE PREPARATION AND SENSORY ASSESSMENT

The panel consisted of four trained individuals. At the beginning, the panellists assessed raw chicken carcasses for conformation, surface colour and subcutaneous fattiness on scale from 1 to 5 (Table 1). Higher score signifies better quality for conformation and colour, while optimal value for subcutaneous fattiness is in the middle of the scale (3 points). After that, the whole carcasses were roasted in the oven at the temperature 190 °C and relative humidity 30% without spices until the final internal temperature reached 85 °C. Internal temperature was measured in *M. pectoralis profundus* at sternum.

The right side of roasted capons was cut for sensory

Table 1: *Subjective scored sensory traits with corresponding scales*
Preglednica 1: *Ocenjevane senzorične lastnosti s pripadajočim razponom ocen*

Part	Trait	Scale
Raw carcass	Conformation	1 (poor) – 5 (excellent)
	Skin colour	1 (pale) – 3 (optimal) – 5 yellowish-pink
	Subcutaneous fattiness	1 (too little) – 3 (optimal) – 5 (too much)
Breast skin	Colour	1 (pale, bluish) – 7 (proper yellow)
	Texture	1 (fragile) – 4 (optimal) – 7 (gummy)
	Fattiness	1 (fatless) – 7 (fatty)
	Flavour	1 (poorly expressed) – 7 (fully expressed)
Meat of breast and thigh	Colour	1 (pale) – 7 (uniform, optimally brown-pink)
	Smell	1 (poor, uncharacteristic) – 7 (typical, well expressed)
	Flavour	1 (poorly expressed) – 7 (fully expressed)
	Juiciness	1 (very dry) – 7 (very juicy)
	Tenderness	1 (very tough) – 4 (optimal) – 7 (very tender, decomposing)
	Fattiness	1 (fatless) – 7 (fatty)
	Mouth feeling	1 (rough structure) – 7 (gentle, fine structure)
	Overall score	1 (unacceptable) – 7 (excellent)

assessment, while left side was stored in the refrigerator at 1 °C until the next day when the shear force was measured. After roasting, the hot samples of breast skin and meat of breast and thigh were assessed (Table 1). These traits were scored on scale from 1 to 7. Traits like texture of skin or tenderness of meat had optimal value in the middle of the scale (4 scores), while others had better quality at higher scores. The colour, texture, fattiness and flavour were assessed in skin, while colour, smell, flavour, juiciness, tenderness, fattiness, and mouth feeling were assessed separately in breast and thigh meat. Coded representative samples were offered to panellists.

Shear force was measured across the muscle fibres with Volodkevich cell on Texture Analyser TA.XT plus apparatus. Cooled breast and thigh meat was cut into 10 mm thick and 12 mm wide slices. The speed of the blade was 2 mm/s and the passage ob blade through sample slice was 9.4 mm. Measurements (in N) were performed in six repetitions per sample slice.

2.3 STATISTICAL ANALYSIS

Statistical analyses were performed by the MIXED procedure in the SAS/STAT (SAS Inst. Inc, 2002). The restricted maximum likelihood method was applied. Statistical model for all traits included fixed effects of age at slaughter (A_i) and genotype (G_j). The interaction between age and genotype (AG_{ij}) was included for smell and fattiness of roasted brest meat and colour of roasted thigh meat on the basis of preliminary analysis. Because all panellists did not attend all assessment events, the effect of panellist was not included in the model. However, the panellists showed heterogeneous variances for most of sensory traits, thus heterogeneous residual variance structure among panellists was assumed. The models for sensory traits written in scalar notation were following:

$$y_{ijk} = \mu + A_i + G_j + e_{ijk} \quad (1)$$

$$y_{ijk} = \mu + A_i + G_j + AG_{ij} + e_{ijk} \quad (2)$$

The model for sheare force (3) included the additonal effect of body part (breast, thigh;). The repeatability model was used because six repeated measurements were taken on each sample slice.

$$y_{ijkl} = \mu + A_i + G_j + P_k + AG_{ij} + e_{ijkl} \quad (3)$$

The Tukey-Kramer adjustment for multiple comparison of differences between pairs of levels for effects with more than two levels was used wherever the effect was siginficant. Sprearman rank correlations were computed between subjectively scored sensory traits and shear force.

3 RESULTS AND DISCUSSION

Conformation of raw carcasses was scored with average value 3.17 points (Table 2), skin colour was assessed close to optimal (3.15), while subcutaneous fattiness was scored between optimal and too much (3.43). Colour (6.02 points) and flavour (5.37 points) of breast skin received high scores. Texture of breast skin was slightly above optimal (4.40 points), while fattiness of breast skin was scored below optimal (2.68 points). Colour of breast (5.75 points) and thigh meat (5.68 points) were scored close to optimally brown-pink. High (superior) average scores received also smell and flavour of breast and thigh meat. Tenderness of breast (4.09 points) and thigh meat (3.84 points) were scored close to optimal, too. Thigh meat was assessed with 2.24 points for fattiness (low fattiness), while breast meat got 1.27 points as practically fatless. Overall score of roasted meat was assessed as good with average value of 5.42 points. Skin colour of raw carcasses, juiciness and mouth feeling of breast meat with standard deviation of 0.82, 0.96 and 0.83 points, respectively, had the largest variation among sensory traits. The smallest variation was found for smell of thigh meat (0.33 point), smell of breast meat (0.36 points), and overall score (0.36 points). The shear force had mean value of 21.22 N with high standard deviation (6.58 N).

The difference between age at slaughter of two groups was 43 days. Age significantly affected the conformation of raw carcasses, colour, texture and flavour of roasted breast skin, smell and tenderness of roasted breast meat, as well as colour, smell and juiciness of roasted thigh meat (Table 3). The genotype had significant effect on conformation and skin colour of raw carcasses, fattiness of roasted breast skin, mouth feeling of roasted breast meat and on tenderness of roasted thigh meat. The effect of genotype was close to significant for seven traits. The interaction between genotype and age was significant for three traits only: smell and fattiness of roasted breast meat and colour of roasted thigh meat. For shear force, age, genotype, as well as the interaction between

Table 2: *Descriptive statistics for sensory traits*
Preglednica 2: *Opisna statistika senzoričnih lastnosti*

Part	Trait	N	Mean	SD	Min.	Max.
Raw carcass	Conformation	228	3.17	0.66	2.0	5.0
	Skin colour	228	3.15	0.82	2.0	5.0
	Subcutaneous fattiness	228	3.43	0.66	1.5	5.0
Breast skin	Colour	228	6.02	0.47	4.5	7.0
	Texture	228	4.40	0.66	2.0	6.0
	Fattiness	228	2.68	0.69	1.5	5.0
	Flavour	228	5.37	0.53	3.5	6.5
Breast meat	Colour	228	5.75	0.54	3.0	6.5
	Smell	228	5.58	0.36	4.5	6.5
	Flavour	228	5.49	0.38	4.5	6.5
	Juiciness	228	4.54	0.96	2.0	6.5
	Tenderness	228	4.09	0.62	2.5	6.0
	Fattiness	228	1.27	0.39	1.0	3.0
	Mouth feeling	227	3.72	0.83	2.0	6.0
Thigh meat	Colour	228	5.68	0.44	4.5	7.0
	Smell	228	5.68	0.33	5.0	6.5
	Flavour	228	5.64	0.37	4.5	6.5
	Juiciness	228	5.23	0.70	2.5	6.0
	Tenderness	228	3.84	0.45	2.5	5.0
	Fattiness	228	2.24	0.57	1.0	5.0
	Mouth feeling	228	5.08	0.56	3.5	6.0
	Overall score	225	5.42	0.36	4.5	6.5
-	Shear force (N)	719	21.22	6.58	7.34	47.03

Table 3: *Sources of variability and significance of effects (P-values) for sensory traits and shear force*
Preglednica 3: *Viri variabilnosti in statistična značilnost vplivov (p-vrednosti) za senzorične lastnosti in rezno trdnost*

		Effect			
Part	Trait	Age	Genotype	Genotype × age	Body part
Raw carcass	Conformation	0.0015	<0.0001	-	-
	Skin colour	0.1887	<0.0001	-	-
	Subcutaneous fattiness	0.3255	0.1206	-	-
Breast skin	Colour	0.0134	0.1645	-	-
	Texture	0.0002	0.0608	-	-
	Fattiness	0.3105	0.0001	-	-
	Flavour	0.0351	0.0607	-	-
Breast meat	Colour	0.0941	0.5823	-	-
	Smell	0.0075	0.2903	0.0263	-
	Flavour	0.2835	0.1127	-	-
	Juiciness	0.1192	0.0595	-	-
	Tenderness	0.0330	0.2696	-	-
	Fattiness	0.1063	0.0871	0.0139	-
	Mouth feeling	0.5019	0.0032	-	-
Thigh meat	Colour	<0.0001	0.3081	0.0291	-
	Smell	<0.0001	0.8440	-	-
	Flavour	0.2391	0.0513	-	-
	Juiciness	0.0317	0.1452	-	-
	Tenderness	0.0554	0.0014	-	-
	Fattiness	0.2059	0.0578	-	-
	Mouth feeling	0.0620	0.0603	-	-
-	Overall score	0.1675	0.0553	-	-
-	Shear force	<0.0001	<0.0001	<0.0001	0.4980

Table 4: *Least square means (LSM) and estimated differences with standard errors (SE) and siginficance for age effect on sensory traits*
Preglednica 4: *Ocenjene srednje vrednosti (LSM) in razlike s standardnimi napakami (SE) in značilnostjo za vpliv starosti pri senzoričnih lastnosti*

		LSM ± SE			
Part	Trait	Age 163 days	Age 198 days	Difference* ± SE	P-value
Raw carcass	Conformation	3.04 ± 0.05	3.27 ± 0.05	-0.23 ± 0.07	0.0015
Breast skin	Colour	5.97 ± 0.04	6.12 ± 0.04	-0.15 ± 0.06	0.0134
	Texture	4.47 ± 0.05	4.21 ± 0.05	0.26 ± 0.07	0.0002
	Flavour	5.34 ± 0.04	5.47 ± 0.05	-0.14 ± 0.06	0.0351
Breast meat	Smell	5.62 ± 0.03	5.50 ± 0.03	0.12 ± 0.05	0.0075
	Tenderness	4.12 ± 0.05	3.96 ± 0.05	0.16 ± 0.08	0.0330
Thigh meat	Colour	5.75 ± 0.04	5.53 ± 0.04	0.21 ± 0.05	<0.0001
	Smell	5.80 ± 0.03	5.61 ± 0.03	0.19 ± 0.04	<0.0001
	Juiciness	5.56 ± 0.04	5.43 ± 0.04	0.13 ± 0.06	0.0317
-	Shear force (N)	19.01 ± 0.30	23.4 ± 0.31	-4.3 ± 0.43	<0.0001

*Difference is expressed as LSM for age 163 days minus LSM for age 198 days / Razlika je predstavljena kot LSM za starost 163 dni minus LSM za starost 198 dni

genotype and age were significant, while the body part was not (Table 3).

3.1 AGE EFFECT

Age at slaughter had a significant effect on nine sensory traits (Table 4). Panellists assessed conformation of raw carcasses of both age groups close to average score (3.04 and 3.27). The older capons had better conformation for 0.23 points. The older group showed more intensive yellow colour of roasted breast skin, the difference was 0.15 points. The texture of breast skin was closer to optimal in older group. Better smell of roasted breast and thigh meat was found in younger group. Both differences were small (0.12 and 0.19 points) but significant.

Capons slaughtered at younger age showed also better tenderness of breast meat for 0.16 points and juiciness of thigh meat for 0.13 points. Altogether, five of nine traits, where differences between age groups were recog-

Table 5: *Least square means and differences with standard errors (above diagonal) between genotypes and statistical significance (below diagonal) for two traits of raw capon carcasses*
Preglednica 5: *Ocenjene srednje vrednosti in razlike s standardnimi napakami (nad diagonalo) med genotipi ter statistično značilnostjo (pod diagonalo) pri dveh lastnostih presnih trupov*

		Genotype		
Genotype	LSM ± SE	Barred Prelux	Sulmtaler	Styrian hen
Conformation				
Barred Prelux	3.15 ± 0.06		−0.41 ± 0.09	0.41 ± 0.09
Sulmtaler	3.57 ± 0.06	<0.0001		0.83 ± 0.09
Styrian hen	2.74 ± 0.06	<0.0001	<0.0001	
Skin colour				
Barred Prelux	4.02 ± 0.06		1.18 ± 0.09	1.42 ± 0.09
Sulmtaler	2.84 ± 0.06	<0.0001		0.24 ± 0.09
Styrian hen	2.60 ± 0.06	<0.0001	0.0180	

LSM – least square mean / ocena srednje vrednost, SE – standard error of estimate / standardna napaka ocene

Table 6: *Least square means and differences between genotypes with standard errors (above diagonal) and statistical significance (below diagonal) for traits of roasted skin and meat*
Preglednica 6: *Ocenjene srednje vrednosti, razlike med genotipi s standardnimi napakami (nad diagonalo) in statistično značilnostjo (pod diagonalo) pri lastnostih pečene kože in mesa*

		Genotype		
Genotip	LSM ± SE	Barred Prelux	Sulmtaler	Styrian hen
Fattiness of roasted breast skin				
Barred Prelux	2.41 ± 0.07		−0.42 ± 0.10	−0.20 ± 0.10
Sulmtaler	2.83 ± 0.07	<0.0001		0.22 ± 0.09
Styrian hen	2.60 ± 0.07	0.1420	0.0532	
Mouth feeling of roasted breast meat				
Barred Prelux	3.81 ± 0.08		0.25 ± 0.11	0.37 ± 0.11
Sulmtaler	3.56 ± 0.07	0.0649		0.13 ± 0.10
Styrian hen	3.43 ± 0.07	0.0022	0.4293	
Tenderness of roasted thigh meat				
Barred Prelux	3.72 ± 0.05		−0.24 ± 0.15	−0.12 ± 0.15
Sulmtaler	3.96 ± 0.05	0.0008		0.12 ± 0.15
Styrian hen	3.84 ± 0.05	0.1610	0.1546	

LSM – least square mean / ocena srednje vrednosti, SE – standard error of estimate / standardna apaka ocene

nised, were assessed better in younger capons. There was no effect of age on flavour, fattiness and mouth feeling of both breast and thigh meat, as well as on overall score (Table 3). The meat of capons at 198 d of age was tougher than meat of younger group; the shear force was larger for 4.3 N (Table 4).

3.2 GENOTYPE EFFECT

The panellists recognised differences among genotypes for five sensory traits. Differences are presented for these traits in Tables 5 and 6. Sulmtaler capons were assessed the best for conformation of raw carcasses, while

Table 7: *Least square means and differences with standard errors (above diagonal) between genotypes and statistical significance (below diagonal) for shear force (in N)*
Preglednica 7: *Ocenjene srednje vrednosti in razlike s standardnimi napakami (nad diagonalo) med genotipi ter statistično značilnostjo (pod diagonalo) pri rezni trdnosti (v N)*

		Genotype		
Genotype	LSM ± SE	Barred Prelux	Sulmtaler	Styrian hen
Barred Prelux	22.8 ± 0.37		4.4 ± 0.53	0.2 ± 0.53
Sulmtaler	18.3 ± 0.37	<0.0001		−4.2 ± 0.53
Styrian hen	22.6 ± 0.37	0.9346	<0.0001	

LSM – least square mean / ocena srednje vrednosti, SE – standard error of estimate / standardna apaka ocene

Table 8: *Least square means and differences between levels of interaction genotypes by age with standard errors (above diagonal) and statistical significance (below diagonal) for three sensory traits*
Preglednica 8: *Ocenjene srednje vrednosti, razlike med nivoji interakcije genotipa in starosti s standardnimi napakami (nad diagonalo) ter statistično značilnostjo (pod diagonalo) pri treh senzoričnih lastnostih*

		Genotype × age					
G × A	LSM ± SE	1 × 1	1 × 2	2 × 1	2 × 2	3 × 1	3 × 2
Smell of roasted breast meat							
1 × 1	5.52 ± 0.06		0.01 ± 0.08	−0.23 ± 0.08	0.06 ± 0.08	−0.07 ± 0.08	−0.01 ± 0.08
1 × 2	5.51 ± 0.06	1.0000		−0.24 ± 0.08	0.05 ± 0.08	−0.08 ± 0.08	−0.02 ± 0.08
2 × 1	5.75 ± 0.05	0.0448	0.0423		0.29 ± 0.07	0.16 ± 0.07	0.22 ± 0.07
2 × 2	5.46 ± 0.05	0.9716	0.9895	0.0016		−0.14 ± 0.07	−0.07 ± 0.07
3 × 1	5.60 ± 0.05	0.9372	0.9083	0.2860	0.4558		0.07 ± 0.07
3 x2	5.53 ± 0.05	1.0000	0.9999	0.0370	0.9360	0.9515	
Fattiness of roasted breast meat							
1 × 1	1.04 ± 0.04		−0.03 ± 0.05	−0.16 ± 0.05	−0.00 ± 0.05	−0.02 ± 0.05	−0.01 ± 0.05
1 × 2	1.07 ± 0.04	0.9920		−0.13 ± 0.05	0.03 ± 0.05	0.01 ± 0.05	0.02 ± 0.05
2 × 1	1.19 ± 0.03	0.0114	0.1343		0.16 ± 0.05	0.14 ± 0.04	0.15 ± 0.05
2 × 2	1.04 ± 0.03	1.0000	0.9919	0.0079		−0.02 ± 0.05	−0.01 ± 0.05
3 × 1	1.06 ± 0.03	0.9976	1.0000	0.0252	0.9976		0.01 ± 0.05
3 x2	1.05 ± 0.03	0.9999	0.9991	0.0176	0.9999	0.9999	
Colour of roasted thigh meat							
1 × 1	5.61 ± 0.06		0.04 ± 0.08	−0.27 ± 0.09	0.11 ± 0.09	−0.14 ± 0.09	0.06 ± 0.09
1 × 2	5.57 ± 0.07	0.9976		−0.31 ± 0.09	0.07 ± 0.09	−0.18 ± 0.09	0.02 ± 0.09
2 × 1	5.88 ± 0.06	0.0345	0.0096		0.39 ± 0.09	0.13 ± 0.09	0.33 ± 0.09
2 × 2	5.49 ± 0.06	0.7974	0.9659	0.0004		−0.26 ± 0.09	−0.06 ± 0.09
3 × 1	5.75 ± 0.06	0.6045	0.3319	0.7112	0.0501		0.20 ± 0.09
3 x2	5.55 ± 0.06	0.9867	1.0000	0.0043	0.9893	0.2215	

LSM – least square mean / ocenjena srednja vrednost lastnosti, SE – standard error of estimate / standardna napaka ocene, G –genotype / genotip (1 – Barred Prelux / grahasti prelux, 2 – Sulmtaler / sulmtaler, 3 – Styrian hen / štajerska kokoš), A – age / starost (1 – 163 days, 2 – 198 days)

Table 9: *Least square means and differences between levels of interaction genotypes by age with standard errors (above diagonal) and statistical significance (below diagonal) for shear force (in N)*
Preglednica 9: *Ocenjene srednje vrednosti, razlike med nivoji interakcije genotipa in starosti s standardnimi napakami (nad diagonalo) ter statistično značilnostjo (pod diagonalo) pri rezni trdnosti (v N)*

		Genotype × age					
G × A	LSM ± SE	1 × 1	1 × 2	2 × 1	2 × 2	3 × 1	3 × 2
1 × 1	19.0 ± 0.53		−7.5 ± 0.75	2.4 ± 0.75	−1.1 ± 0.75	−2.5 ± 0.75	−4.6 ± 0.75
1 × 2	26.5 ± 0.53	<0.0001		9.9 ± 0.75	6.4 ± 0.75	4.9 ± 0.75	2.9 ± 0.75
2 × 1	16.6 ± 0.53	0.0236	<0.0001		−3.5 ± 0.75	−5.0 ± 0.75	−6.0 ± 0.75
2 × 2	20.1 ± 0.53	0.7032	<0.0001	0.0003		−1.5 ± 0.75	−3.5 ± 0.75
3 × 1	21.6 ± 0.53	0.0148	<0.0001	<0.0001	0.3714		−2.0 ± 0.75
3 × 2	23.6 ± 0.53	<0.0001	0.0035	<0.0001	0.0003	0.0912	

LSM – least square mean / ocenjena srednja vrednost lastnosti, SE – standard error of estimate / standardna napaka ocene, G – genotype / genotip (1 – Barred Prelux / grahasti prelux, 2 – Sulmtaler / sulmtaler, 3 – Styrian hen / štajerska kokoš), A – age / starost (1 – 163 days, 2 – 198 days)

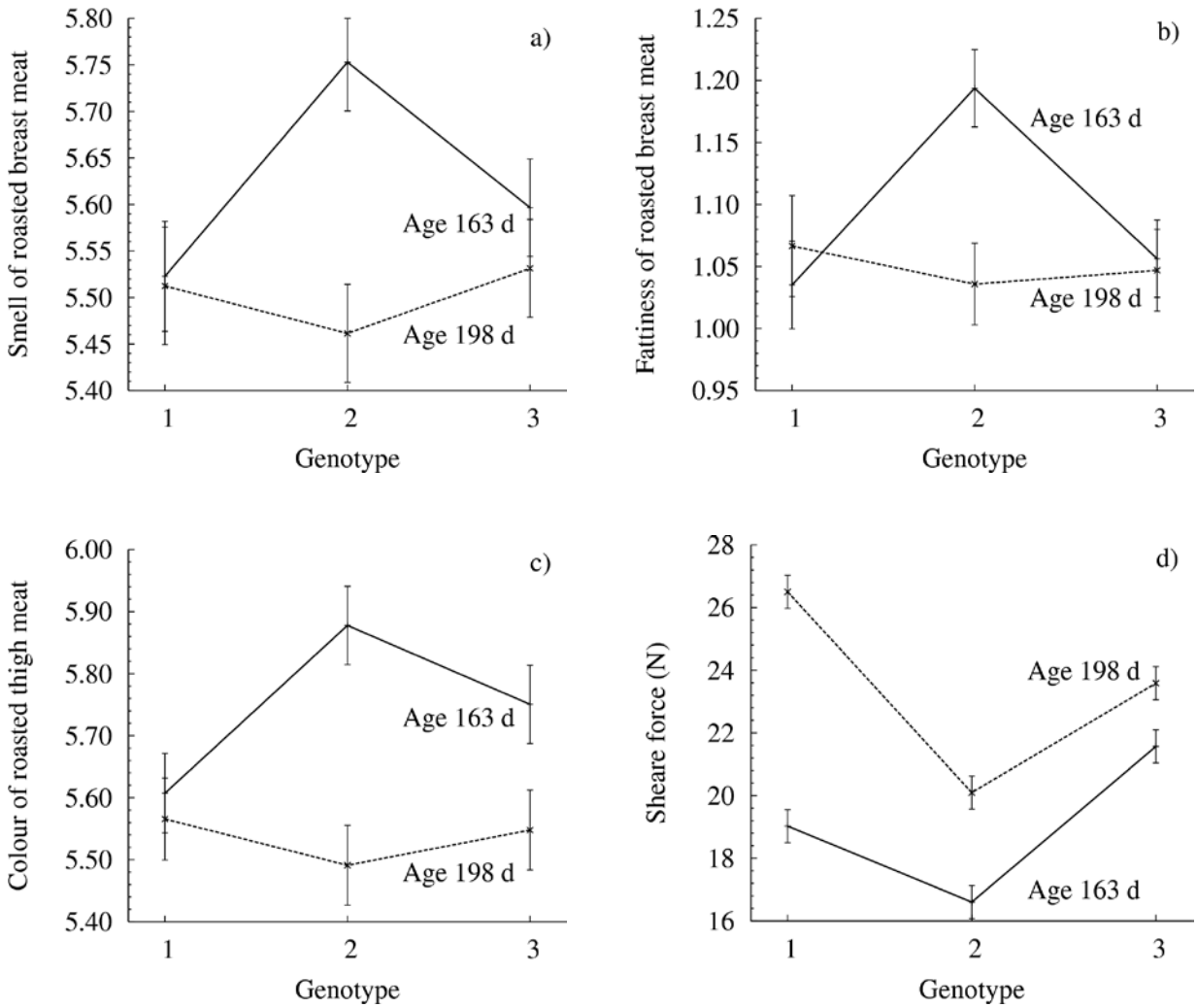

Figure 1: *Interaction between genotype and age in the sensory traits (a-c) and sheare force (d).*
Slika 1: *Interakcija med genotipom in starostjo pri treh senzoričnih lastnostih (a-c) ter rezni trdnosti (d).*

Table 10: *Spearman correlation coefficients between sensory traits and shear force (N=60)*
Preglednica 10: *Korelacijski koeficienti po Spearmanu med senzoričnimi lastnostmi in rezno trdnostjo (N=60)*

	Breast		Thigh	
Sensory trait	Corr. coeff.	P-value	Corr. coeff.	P-value
Colour	−0.35	0.0060	−0.32	0.0132
Smell	−0.32	0.0129	−0.27	0.0388
Flavour	−0.06	0.6456	−0.40	0.0016
Juiciness	−0.12	0.3500	−0.07	0.6147
Tenderness	−0.43	0.0007	−0.57	<0.0001
Fattiness	−0.27	0.0345	−0.21	0.1090
Mouth feeling	−0.07	0.6002	−0.04	0.7365
Overall score	−0.22	0.0915	−0.31	0.0166

capons of Styrian hen were the worst (Table 5). Barred Prelux capons had for 0.41 points better conformation in comparison with capons of Styrian hen and for 0.41 points worse conformation in comparison with Sulmtaler capons. The difference between Sulmtaler capons and capons of Styrian hen was 0.83 points. Great differences were estimated between genotypes for colour of raw carcasses. Barred Prelux capons were for 1.18 points better compared to Sulmtaler capons and for 1.42 points better than capons of Styrian hen. Difference between Sulmtaler capons and capons of Styrian hen was smaller (0.24 points). Differences among genotypes for fattiness of raw carcasses were not significant.

The panellist recognised difference of −0.42 points between Barred Prelux and Sulmtaler capons for fattiness of roasted breast skin (Table 6). Difference between Sulmtaler capons and capons of Styrian hen was close to significant. The best score for mouth feeling of roasted breast meat was given to Barred Prelux capons (3.81 points). They were significantly better for 0.25 points from Sulmtaler capons and for 0.37 points from capons of Styrian hen. The difference between the last two was not significant for mouth feeling of roasted breast meat.

The shear force (Table 7) of capons of Barred Prelux and Styrian hen was similar (22.8 N and 22.6 N), and the difference was not siginficant. The Sulmtaler capons had more tender meat compared to both other genotypes for −4.4 N (Barred Prelux) and 4.2 N (Styrian hen).

3.3 GENOTYPE BY AGE INTERACTION

Three sensory traits were influenced by interaction between genotype and age (Table 3): smell and fattiness of roasted breast meat and colour of roasted thigh meat (Table 8). The most important difference in all three traits is between age groups within Sulmtaler breed. The age at slaughter within genotype did not influence so much on these traits in capons of Barred Prelux and Styrian hen (Figure 1, a–c). Capons of Sulmtaler were superior in smell of roasted breast meat and colour of roasted thigh meat at age of 163 days compared to other two genotypes. They had also fatter breast meat, but at later age differences between genotypes disappeared.

The shear force had lower values in younger groups of capons in all the genotypes and it get worse by age (Fig. 1d, Table 9). However, there were great differences among genotypes. The greatest change to worse was in Barred Prelux capons (7.5 N) and the smallest in capons of Styrian hen (2.0 N). The change of shear force in Sulmtaler capons was 3.5 N. The shear force for Sulmtaler capons at age 198 days did not differ from shear force for both other genotypes at age 163 days. Regarding this trait, Sulmtaler capons can be fattened to older age compared to the other two genotypes, while for Barred Prelux capons, the shorter fattening is recommended. The age at slaughter does not influence the shear force in capons of Styrian hen up to 198 days.

3.4 RELATIONSHIP BETWEEN SHEAR FORCE AND SENSORY TRAITS

Shear force is an objective measure of meat tenderness, while sensory traits scored by panellists are subjective. Spearman correlation coefficients were calculated between shear force and sensory traits for breast and thigh meat separately (Table 10). Most of correlations between shear force and sensory traits were significant. The highest correlations were between shear force and tenderness of breast (−0.43) and thigh (−0.57) meat. Negative values of correlations are the consequence of scale for tenderness where score 1 means tough and score 7 tender meat. Moderate negative correlations were between shear force and colour (−0.35 for breast and −0.32 for thigh) and between shear force and smell (−0.32 for breast and −0.27 for thigh). Meat with higher shear force was paler and had poorer smell. The correlation between shear force and flavour was significant for thigh meat (−0.40), while the correlation between shear force and fattiness was significant for breast meat (−0.27). Overall score was correlated with shear force of thigh meat (−0.31) and showed tendency for breast meat. Meat with higher shear force had worst overall score.

4 CONCLUSIONS

Age at slaughter significantly affected nine sensory traits. Conformation of raw carcass and colour, texture and flavour of roasted breast skin were better in older capons, while smell of roasted meat, colour and juiciness of roasted thigh meat were better in younger capons. Additionally, shear force increased at older age at slaughter.

There were seven sensory traits where the effect of genotype was close to significant: texture and flavour of roasted breast skin, juiciness of roasted breast meat, flavour, fattiness and mouth felling of roasted thigh meat as well as overall score. Differences between capons of Barred Prelux, Sulmtaler and Styrian hen were significant in five traits: conformation and skin colour of raw carcasses, fattiness of roasted breast skin, mouth felling of roasted breast meat and tenderness of roasted thigh meat.

Shear force was affected by age and genotype, while effect of body part was not significant. Shear force was moderately correlated with subjective scored tenderness of breast and thigh meat. Other correlations with sensory traits were lower.

Thus we can conclude that decision which genotype is the most suitable for capon production and at which age to slaughter depends on which sensory traits are more important or actually which sensory traits are more important for consumers.

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