**SLOVENSKÁ POĽNOHOSPODÁRSKA UNIVERZITA V NITRE**

**Fakulta agrobiológie a potravinových zdrojov**

**Katedra špeciálnej zootechniky**

**Z B O R N Í K**

**z medzinárodného workshopu**

# VYUŽITIE PRIMITÍVNYCH PLEMIEN OŠÍPANÝCH PRE VÝROBU REGIONÁLNYCH MÄSOVÝCH VÝROBKOV

**NITRA**

**15. – 17. máj 2018**

**Slovenská poľnohospodárska univerzita v Nitre**
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## *OBSAH*

# *ÚVOD*

*Chov ošípaných bol až do medzivojnového obdobia v minulom storočí realizovaný väčšinou malovýrobným, resp. extenzívnym spôsobom. Jeho cieľom bolo v našich geografických polohách hlavne samozásobovanie obyvateľstva tradičnou bravčovinou s vysokým podielom tučných častí a zabezpečenie energeticky bohatým zdrojom výživy pre prevažne manuálne pracujúce obyvateľstvo.*

*S tým úzko súviseli chované plemená a typy ošípaných. V centrálnej Európe sa na chov využívali rôzne pôvodné plemená, ktoré sa prevažne spontánne šírili v jednotlivých regiónoch Rakúsko-Uhorskej monarchie, ale aj v ostatných menej rozvinutých častiach Európy. Išlo o desiatky rôznych extenzívnych plemien vyznačujúcich sa dobrou reprodukciou a konštitučnou pevnosťou, ale nízkou rastovou schopnosťou, vysokým podielom tuku a nízkou ekonomickou efektívnosťou produkcie mäsa. Dôsledkom extenzívneho chovu si tieto plemená udržiavali dobrú kvalitu mäsa z aspektu možnosti tradičného konzervovania údením, prípadne sušením. Tzn., že si zachovali vysoký obsah celkového aj intramuskulárneho tuku, s čím súviselo aj vhodné pH a farba mäsa, nízke straty vody, jemnosť mäsa a jeho chuťové vlastnosti.*

*Po 2. svetovej vojne sa v rámci spriemyselňovania výroby bravčového mäsa začali uplatňovať plemená „moderné“ - s rýchlym rastom, vysokým podielom svaloviny a nízkym obsahom tuku. Na zmenu typu sa do väčšiny štátov introdukovali viaceré anglické, nemecké, dánske, holandské plemená, ktoré v konečnom dôsledku z chovu takmer úplne vytlačili pôvodné „primitívne“ plemená. Tak vznikli mnohé nové plemená, resp. kríženc, ktoré v posledných desaťročiach dali základ pre tvorbu priemyselných hybridov. Vznikli „globálne“ genetické firmy, ktoré pri tvorbe hybridov využívajú najnovšie progresívne genetické postupy a s pomocou výpočtovej techniky zapájajú do selekčných a hybridizačných programov milióny prasníc z rôznych častí sveta. Tak sa podarilo vytypovať a nakumulovať najprodukčnejšie genotypy ošípaných, ktoré v priemyselnom chove dosahujú mimoriadne výsledky - počet odstavených prasiat za rok 30 - 35 na prasnicu, priemerné denné prírastky vo výkrme 800 až 1000 gr a podiel mäsa v jatočnom tele 55 až 60 %. Moderné kombináty chovajú na farmách 5 až 10 000 ks prasníc, výkrmne vykŕmia ročne 100 až 150 tisíc jatočných ošípaných.*

*Obyvateľstvo je zásobované bravčovým mäsom prevažne prostredníctvom obchodných reťazcov, ktoré využívajú globálny trh a migráciu mäsa nad-kontinentálnym spôsobom. Svojsky a často pokútnym spôsobom rieši udržiavanie kvality mäsa*

*v obchodných baleniach, čo vyvoláva u stále väčšej časti spotrebiteľov nespokojnosť až fóbiu pri konzumovaní mäsa.*

*Súčasný trh hľadá riešenia, ktoré sú orientované na využitie starých „primitívnych" plemien ošípaných na produkciu nových produktov prevažne na báze údenia, sušenia a fermentovania mäsových výrobkov s niektorými vlastnosťami tradičných regionálnych výrobkov. V podmienkach Slovenska, Chorvátska, Poľska, Maďarska, Srbska, Talianska, Španielska, Portugalska a pod. sa na trhoch objavuje rad špecifických produktov, ktoré sú určené pre náročných spotrebiteľov. Majú vyhľadávanú kvalitu a pre výrobcov sú ekonomicky zaujímavé. Využívajú sa pritom rozmanité pôvodné primitívne plemená, s požadovanou kvalitou mäsa pre tieto druhy výrobkov.*

*Katedra špeciálnej zootechniky, Fakulty agrobiológie a potravinových zdrojov sa v priebehu posledných 4 rokov orientuje na možnosť využitia pôvodného primitívneho plemena Uhorska - mangalicu, pre produkciu mäsa s požadovanými kvalitatívnymi vlastnosťami, pri zohľadnení ekonomickej úspešnosti výroby a vytvorení produktu s pridanou hodnotou v oblasti obsahu omega mastných kyselín a technologických a fyzikálno-chemických vlastností mäsa. Súčasne v spolupráci s podnikom Tauris Nitria hľadá spôsoby, ako takto vyrobené mäso finalizovať v tradičných špecifických výrobkoch.*

*Bola nadviazaná veľmi zaujímavá spolupráca s univerzitami v Bydgoszczi (Pl), Zagrebe (K), v Prahe a v Českých Budejoviciach (ČR), ktorej cieľom je konfrontovať využiteľnosť primitívnych ošípaných, porovnať využitie a využiteľnosť primitívnych plemien a dohodnúť ďalšiu spoluprácu pri testovaní a finalizovaní primitívnych plemien v jednotlivých štátoch.*

*To bude predmetom diskusie na medzinárodnom workshope, súčasťou ktorého bude aj degustácia mäsových výrobkov z jednotlivých účastníckych štátov. Okrem problematiky mäsa sa bude na workshope prezentovať aj problematika včelárstva a využitia včelých produktov na Slovensku a v Chorvátsku. Rokovanie bude doplnené aj degustáciou včelárskych produktov.*

*Želáme všetkým účastníkom medzinárodného workshopu zaujímavé rokovania a príjemný pobyt na Slovensku.*

*organizátori*

# UTILIZATION OF MANGALITSA PIGS IN CROSSING WITH SLOVAK LARGE WHITE FOR THE IMPROVEMENT OF FATTENING, PRODUCTION PARAMETERS AS WELL AS QUALITY OF MEAT

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Today, the Mangalitsa pig is a representative example of the success of preserving endangered breeds, because is one of the last indigenous pig breeds in Eastern Europe. This breed is known for maturing late and for its vitality, resistance to climate conditions as well as longevity (Egerszegi et al., 2003). Mangalitsa is one of the fattest pigs in the world. Generallly had 65-70 % of fat in the carcass. The lean meat makes only 30-35 % compared to pig meat breeds, which have over 50 % (Egerszegi et al., 2003). Meat and lard from Mangalitsa pigs as well as from other autochthonous pig breeds, show interesting quality (primarily in colour, fat content as well as its composition) and have been transformed into unique highly priced –dry cured products and dry fermented sausages ("kulen") (Cava et al., 2003; Galián et al., 2007, Tomovic et al., 2016). Most of these products still rely primarily on local, traditional manufacturing processes (Tomovic et al. 2016). Nowadays, crossings between pig meat breeds and indigenous pig breeds are realized for production of new unique pork products (Tomovic et al., 2014). Crossing with pig meat breed is often done to improve the productivity of the indigenous animals without greatly affecting the quality of meat as well as reducing the level of intramuscular fat (Edwards, 2005, Pugliese and Sirtori, 2012). For these reason, the aim of this study was use to Mangalitsa pig for crossing with pig meat breed Slovak Large White and improved fattening, production parameters as well as quality of meat.

## Material and methods

The experiment was realized in the Experimental centre of farm animal (ECFA) near the Department of Animal Husbandry at Slovak University of Agriculture in Nitra. In the study, 95 fattened pigs were used. Pigs were divided into groups according to different genotype: Mangalitsa (n=24), Slovak Large White (n=10), crossbreeds F1 (SLW x Ma, n=56) and crossbreeds F11 (F1 x SLW, n=5). The fattening period lasted from 30 kg to 100 kg of live weigh resp. 130 kg of live weight.

## Results and conclusions

Fattening of Mangalitsa lasted 205 days, indicating significantly ($P < 0.001$) the longest fattening compared to SLW (84 days,) F1 (SLW x Ma, 112 days) as well as F11 (F1 x SLW, 68 days). Differences between SLW and crossbreeds were not significant. Mangalitsa pigs achieved significantly ($P < 0.001$) the lowest ADG (442,9 g) and crossbreeds F11 the highest (1038 g), whereby between SLW (834.4 g) and crossbreeds F1 (754.7) were not found significant differences. As regard feed intake per 1 kg of gain, it was impacted primarily by genotype (86.73 %. $P < 0.01$). Mangalitsa pigs had significantly the highest feed intake (6.6 kg, $P < 0.001$) compared to SLW (2.7 kg), crossbreeds F1 (2.7 kg) as well as F11 (2.8 kg). From the obtained results, it can be concluded that Mangalitsa breed had the worst parameters for breeding than their crossbreeds and SLW. However, the crossing Mangalitsa breed with Slovak Large White improved fattening parameters, because crossbreeds F11 had better growth parameters as well as feed intake than Slovak Large White and crossbreeds F1.

Mangalitsa pigs had significantly the highest average backfat thickness (5.9 cm,) compared crossbreeds F1 (3.9 cm), F11 (2.8 cm) and SLW (1.7 cm), which was the lowest ($P < 0.001$). However, between crossbreeds F1 and F11 significant differences were found ($P < 0.001$). On the contrary, Mangalitsa pigs had significantly ($P < 0.001$) the lowest loin eye area (31.1 $cm^2$) compared to crossbreeds F1 (42.5 $cm^2$), F11 (44.4 $cm^2$) as well as SLW (48 $cm^2$). Although loin eye area of SLW was the highest, no significant differences between SLW and crossbreeds F1 and F11 were determined. As regard the percentage of lean meat cuts, it was significantly affected by genotype (68.29 %, $P < 0.001$) and slaughter weight (8.18 %, $P < 0.05$). Similarly the percentage of fat cuts was significantly impacted by genotype (63.77 %, $P < 0.001$), as well as slaughter weight (13.74 %, $P < 0.01$). Mangalitsa pigs had significantly the lowest percentage of LMC in carcass (33.9 %) compared to crossbreeds F1 (41.6 %), F11 (44.6 %) and SLW (51.1 %), whereby SLW had the highest percentage of LMC in carcass ($P < 0.001$). Between crossbreeds statistical differences were not found. Within percentage of fat cuts in the carcass, Mangalitsa pigs had the highest percentage (35.5 %) than crossbreeds F1 (28.2 %), F11 (22.5 %) and SLW (16.4 %), where SLW had the lowest percentage of fat cuts in the carcass ($P < 0.001$). However between crossbreeds F1 and F11 significant differences were also found ($P < 0.001$).

It can be confirmed by our results, that Mangalitsa pigs had higher content of fat in the carcass than their crossbreeds and SLW. The first phase of crossing Mangalitsa pigs with SLW improved production parameters of crossbreeds F1 compared to Mangalitsa. However, the production parameters of crossbreeds F11 were resemble to SLW and crossbreeds F11 achieved better values of parameters than crossbreeds F1.

Regarding proximate composition, moisture content of MLD was significantly affected by genotype (37.70 %, $P < 0.001$). MLD of SLW had higher moisture content in MLD (74.2 %) compared to Mangalitsa pigs (73.5 %), crossbreeds F1 (72.9 %) and F11 (72 %), indicating a very high significant differences between genotypes ($P < 0.001$). Protein content of MLD was significantly impacted by genotype (26.23 %, $P < 0.001$). Crossbreed F1 as well as F11 had significantly higher protein content in MLD (F1: 24.6 %, F11: 25.1 %) than Mangalitsa (24.3 %) and SLW (23.7 %, $P < 0.05$). It is in relationship with moisture content, where crossbreeds had lower moisture content of MLD. Due to this fact, crossbreeds had higher protein content in MLD than Mangalitsa and SLW. As regards intramuscular fat content, it was influenced by genotype (10.47 %, $P < 0.05$). Mangalitsa pigs had the highest percentage of intramuscular fat (1.8 %) than their crossbreeds F1 (1.6 %), F11 (1.2 %) and SLW (1.2 %), indicating a high significant differences between Mangalitsa and SLW ($P < 0.001$). Cholesterol content was significantly affected by genotype (48.21 %, $P < 0.001$) and IMF (19.19 %, $P < 0.001$). Cholesterol content of MLD was significantly higher in Mangalitsa (42.08 mg. 100 $g^{-1}$) and their crossbreeds (F1: 41.5 mg. 100 $g^{-1}$, F11: 41.8 mg. 100 $g^{-1}$) compared to SLW (20.4 mg. 100 $g^{-1}$, $P < 0.001$) what is probably due to higher content of fat in the carcass.

From obtained results follow, that crossbreeds F1 as well as F11 had lower moisture content and higher protein content in MLD, because moisture and protein content are in negative relationship. However, the crossing Mangalitsa with SLW improved percentage of IMF in MLD of crossbreeds F1 in relation to SLW. Then the crossing F1 with SLW decreased percentage of IMF due to effect of breed SLW.

As regards fatty acid composition of IMF in MLD, IMF of MLD from SLW was significantly more saturated (39.49 g. 100 $g^{-1}$ FAME, $P < 0.001$) compared to Mangalitsa (36.35 g. 100 $g^{-1}$ FAME), crossbreeds F1 (36.27 g. 100 $g^{-1}$ FAME) as well as F11 (35.80 g. 100 $g^{-1}$ FAME). IMF of MLD from SLW had significantly higher content of MUFA (54.52 g. 100 $g^{-1}$ FAME) in relation to Mangalitsa (50.42 g. 100 $g^{-1}$ FAME), crossbreeds F1 (50.47 g. 100 $g^{-1}$ FAME) and F11 (48.88 g. 100 $g^{-1}$ FAME). Between Mangalitsa pigs and crossbreds F1 were not determined significant differences as well as between

Mangalitsa pigs and crossbreeds F11, where crossbreeds F11 had the lowest content of MUFA than other genotypes. However, PUFA was significantly ($P < 0.001$) lowest in MLD of SLW (8.33 g. 100 $g^{-1}$ FAME) in relation to Mangalitsa (12.75 g. 100 $g^{-1}$ FAME) and their crossbreeds (F1: 12.78 g. 100 $g^{-1}$ FAME, F11: 12.49 g. 100 $g^{-1}$ FAME). From obtained results follow, that SLW had IMF more saturated as well as monounsaturated and less polyunsaturated than Mangalitsa and their crossbreeds.

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# KVALITA MASA U PRASAT PŘEŠTICKÉ ČERNOSTRAKATÉ
# Meat quality in Black-Pied pigs

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Ve sledovaném souboru byla zjištěna u plemene přeštické černostrakaté při výkrmu v provozních podmínkách nižší růstová intenzita, intenzivnější vývoj tukové tkáně a nižší hodnota jatečně upraveného těla. Tato skutečnost je pro původní plemena prasat charakteristická. Ukazatele jatečné hodnoty byly vyhodnoceny v závislosti na porážkové hmotnosti a pohlaví. Se zvyšující se porážkovou hmotností se zvyšovala průměrná výška hřbetního tuku a podíl svaloviny klesal. Kvalita masa byla hodnocena velmi pozitivně. Maso nejtěžší hmotnostní kategorie mělo nejvyšší podíl intramuskulárního tuku. Doporučená hodnota byla dosažena ve všech sledovaných hmotnostních kategoriích (2,40–2,88 %).

**Klíčová slova:** prase, přeštické černostrakaté, jatečná hodnota, kvalita masa

Lower growth ability, higher adipose tissue development and lower carcass value were characteristic of Prestice Black-Pied breed during fattening in standard rearing conditions. These findings are typical of native breeds of pigs. Parameters of carcass value were evaluated on the basis of slaughter weight and sex. With increasing slaughter weight average backfat thickness, and lean meat content was decreasing. Meat quality received a very positive evaluation. The meat of the heaviest weight category had the highest intramuscular fat content. The recommended value of IMF content was reached in all studied weight categories (2.40–2.88%).

**Key words:** pig, Black-Pied breed, carcass, meat quality

## 1. Úvod

Plemeno přeštické černostrakaté (PC) je původní české plemeno, kterému v nedávné době hrozil zánik. Pro svoji odolnost, nenáročnost, přizpůsobivost, dobré mateřské vlastnosti a kvalitu masa, zejména vyšší podíl intramuskulárního tuku, bylo v roce 1992 zařazeno do genetických zdrojů. Početní stavy se od roku 2012 výrazně navýšily a v posledních letech dochází k ustálení počtu prasat. Více než polovina chovů však chová do 10 prasat, čímž nastává problém v udržení genetické variability uzavřené populace. V intenzivních podmínkách při krmení standardními krmnými směsmi dosahuje plemeno PC při porážkové hmotnosti 115–120 kg průměrný denní přírůstek od narození 580–620 g, podíl svaloviny 48–52 % a průměrnou výšku hřbetního tuku 28–40 mm.

Podle autorů LEENHOUWERS a MERKS (2013) se tradiční plemena rozdělují na plodná plemena s dobrými vlastnostmi výkrmnosti (např. sedlové, pulawské), která jsou vhodná pro produkci masa v ekologických chovech, zejména jsou-li křížena s kanci konvenčních bílých plemen, kteří dodají libovost. A na masná plemena chovaná pro speciální masnou produkci (např. iberské a cinta senese), která nejsou vhodná pro ekologický chov z důvodu nízké plodnosti a vysoké protučněnosti, ale jejich hodnota je ve specifickém

mase a kvalitě tuku. MARTINS *et al.* 2002 konstatují, že pro ekonomickou udržitelnost chovu jsou důležité nejenom užitkové vlastnosti prasat, ale také požadavky trhu.

## 2. Materiál a metodika

U skupiny prasat plemene přeštické černostrakaté byl sledován vliv porážkové hmotnosti a vliv pohlaví na jatečnou hodnotu a kvalitu masa. Do experimentu bylo zařazeno 81 prasat (45 vepříků a 36 prasniček), chovaných v běžných podmínkách a krmených *ad libitum* standardní krmnou směsí. Na základě porážkové hmotnosti byla prasata rozdělena do 3 kategorií: PH1 (75–99,9 kg), PH2 (100–114,9 kg) a PH3 (115–140 kg). Data byla zpracována prostřednictvím programu Statistica 10. Výpočty byly provedeny pomocí jednofaktorové ANOVY, Kruskal-Wallisovy ANOVY a dvouvýběrového t-testu.

## 3. Výsledky a diskuze

### *Vliv porážkové hmotnosti*

V jednotlivých hmotnostních intervalech (tabulka 1) byla zjištěna porážková hmotnost 90,7 kg (160,2 dní věku), 105,9 kg (172,9 dní věku) a 119,0 kg (182,6 dní věku). Se zvyšující se hmotností se statisticky významně zvyšovala výška hřbetního tuku (35,2, 38,9 a 44,2 mm). Na podíl svaloviny (48,7, 48,8 a 48,5 %) porážková hmotnost vliv neměla. Velmi dobrou kvalitu masa (tabulka 2) potvrdily vyšší hodnoty $pH_{45}$ (6,65, 6,57 a 6,61) a nízké hodnoty $pH_{24}$ (5,49, 5,42 a 5,52). Byla sledována také světlost masa L* (53,3, 52,8 a 52,1). S narůstající porážkovou hmotností se statisticky průkazně zvyšovala ztráta masové šťávy odkapáním (1,65, 2,55 a 3,64 %). Jakostní odchylka masa PSE byla ve sledovaném souboru zjištěna pouze u 1,23 % jedinců. Podíl intramuskulárního tuku se nevýznamně zvyšoval (2,40, 2,65 a 2,88 %). Statisticky významně se snižovala síla střihu vařeného masa (8,50, 7,18 a 6,52 kg). V jednotlivých hmotnostních kategoriích byl podíl n-3 PUFA (0,35, 0,39 a 0,33 %), podíl n-6 PUFA (7,73, 7,67 a 6,81 %) a poměr n-6 PUFA:n-3 PUFA (24,5, 25,6 a 22,5 %).

### *Vliv pohlaví*

Vepříci byli poraženi ve hmotnosti 108,9 kg (170,0 dní věku) a prasničky ve hmotnosti 106,6 kg (106,6 dní věku). U vepříků byla naměřena vyšší výška hřbetního tuku (41,2 mm) ve srovnání s prasničkami (39,4 mm) a byl u nich zjištěn nepatrně nižší podíl svaloviny (48,6, resp. 48,7 %), jak je zřejmé z tabulky 1. Z ukazatelů kvality masa (tabulka 2) byl zjištěn statisticky významný rozdíl pouze u podílu intramuskulárního tuku (vepříci 2,91 %, prasničky 2,47 %). Ostatní ukazatele kvality masa byly velmi podobné ($pH_{45}$ – 6,62, resp. 6,60, $pH_{24}$ – 5,51, resp. 5,45, L* – 52,82, resp. 52,43, síla ve střihu vařeného masa – 7,42, resp. 7,04 kg). Prasničky vykázaly podíl n-3 PUFA – 0,36 %, podíl n-6 PUFA – 7,48 % a poměr n-3 PUFA:n-6 PUFA – 24,1. U vepříků byl zjištěn podíl n-3 PUFA – 0,34 %, podíl n-6 PUFA – 7,15 % a poměr n-3 PUFA:n-6 PUFA – 23,8 %.

VÁCLAVKOVÁ *et al.* (2014) zjistili u plemene přeštické černostrakaté při porážkové hmotnosti 114,13 kg průměrnou výšku hřbetního tuku 23,42 mm, podíl svaloviny 51,14 % a podíl intramuskulárního tuku 2,31 %. U prasat plemene zlotnické strakaté při porážkové hmotnosti 107,12 kg byla naměřena průměrná výška hřbetního tuku 29,49 mm, $pH_{45}$ 6,33 a podíl intramuskulárního tuku 1,87 % (BOCIAN *et al*., 2012). KELLY *et al. (*2007) uvádí u plemene anglické sedlové při porážkové hmotnosti 89,7 kg výšku hřbetního tuku 14,3 mm (P2) a podíl svaloviny 54,1 %. MAASSEN-FRANCKE *et al.* (1991) zjistili u plemene angelské sedlové podíl svaloviny 45,2 % (100 kg). KRIETER a THOLEN (2001) považují za optimální podíl IMT 2,5 %. CANDEK POTOKAR *et al.* (2003) uvádí

u plemene krškopolje vyšší podíl IMT než 3 %. BAULAIN *et al.* (2000) potvrdili rozdíl v podílu IMT mezi pohlavím u plemen angelnské sedlové, bentheimerské černostrakaté a švábsko-halské sedlové.

## Závěr

PC plemeno nemůže konkurovat v podílu svaloviny moderním masným plemenům a hybridům. Pro ekonomickou udržitelnost je nutné finanční zohlednění plemene, ze kterého pochází prodávané maso. Proto vzniklo garantované označení „Přeštické originál“, aby měl zákazník jistotu, že si kupuje maso z přeštického černostrakatého prasete a farmáři mohli získat lepší ceny za své produkty.

Jelikož se maso PC prasat vyznačuje velmi dobrými senzorickými vlastnostmi, zejména díky vyššímu podílu intramuskulárního tuku, je vhodné pro speciální kulinářské úpravy. Také vyšší výška hřbetního tuku představuje možnost výroby specifických produktů. Pro specifické masné produkty je možné využít rozdílnost složení jatečného těla v různé porážkové hmotnosti. Při nižší porážkové hmotnosti se maso hodí například pro výrobu šunky, u vyšší porážkové hmotnosti pro výrobu kvalitního špeku a sádla. Další cestou jak snížit náklady a zvýšit zisky je využití alternativních krmných směsí, alternativních způsobů chovu, ekologického způsobu chovu a produkovat tak výrobky s jistou přidanou hodnotou, za kterou je zákazník ochoten zaplatit. Vhodným složením krmných směsí lze významně ovlivnit obsah mastných kyselin tak, aby lépe vyhovoval požadavkům lidské výživy. Pro udržitelnost chovu genetického zdroje je nutná vhodná reklama a propagace jeho chovu a produktů z něj.

Tabulka 1. Vliv porážkové hmotnosti a pohlaví na kvantitativní ukazatele vepřového masa

| Ukazatel | 75–99,9 kg | | 100–114,9 kg | | 115–140 kg | | Vepříci | | Prasničky | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ | $s_x$ | $\bar{x}$ | $s_x$ | $\bar{x}$ | $s_x$ | $\bar{x}$ | $s_x$ | $\bar{x}$ | $s_x$ |
| Věk (dny) | $160{,}2^{a,B}$ | *11,1* | $172{,}9^{a,c}$ | *11,3* | $182{,}6^{B,c}$ | *8,6* | $170{,}0^{A}$ | *13,3* | $177{,}4^{A}$ | *12,7* |
| Porážková hmotnost (kg) | $90{,}7^{A,B}$ | *7,0* | $105{,}9^{A,C}$ | *2,4* | $119{,}0^{B,C}$ | *6,52* | 108,9 | *14,0* | 106,6 | *11,3* |
| Prům. výška tuku (mm) | $35{,}2^{a,B}$ | *4,1* | $38{,}9^{a,C}$ | *6,2* | $44{,}2^{B,C}$ | *5,3* | 41,2 | *0,7* | 39,4 | *0,6* |
| Podíl svaloviny – ZP (%) | 48,7 | *0,6* | 48,8 | *0,6* | 48,5 | *0,8* | 48,6 | *0,7* | 48,7 | *0,7* |

*$^{A,B,C,a}$Průměry označené stejnými malými písmeny jsou statisticky významné ($P < 0{,}05$), resp. průměry označené stejnými velkými písmeny jsou statisticky vysoce významné ($P < 0{,}01$).*

Tabulka 2. Vliv porážkové hmotnosti a pohlaví na kvalitativní ukazatele masa

| Ukazatel | 75–99,9 kg | | 100–114,9 kg | | 115–140 kg | | Vepříci | | Prasničky | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ | $s_x$ | $\bar{x}$ | $s_x$ | $\bar{x}$ | $s_x$ | $\bar{x}$ | $s_x$ | $\bar{x}$ | $s_x$ |
| $pH_{45}$ | 6,65 | *0,21* | 6,57 | *0,29* | 6,61 | *0,27* | 6,62 | *0,25* | 6,60 | *0,27* |
| $pH_{24}$ | 5,49 | *0,10* | 5,42 | *0,22* | 5,52 | *0,19* | 5,51 | *0,18* | 5,45 | *0,20* |
| Světlost masa – L* | 53,3 | *2,3* | 52,8 | *2,1* | 52,1 | *2,6* | 52,82 | *2,48* | 52,43 | *2,34* |
| Odkap (%) | $1,65^{a,B}$ | *0,6* | $2,55^{a,c}$ | *1,5* | $3,64^{B,c}$ | *2,0* | 2,84 | *1,95* | 2,75 | *1,57* |
| Intramuskulární tuk (%) | 2,40 | *0,75* | 2,65 | *0,83* | 2,88 | *1,00* | $2,91^{a}$ | *0,98* | $2,47^{a}$ | *0,78* |
| Střih – vařené maso (kg) | $8,50^{a,B}$ | *1,41* | $7,18^{a}$ | *1,55* | $6,52^{B}$ | *2,08* | 7,42 | *1,82* | 7,04 | *2,01* |
| ∑ MUFA (%) | 48,9 | *2,5* | 48,9 | *3,6* | 49,4 | *3,94* | 49,6 | *4,0* | 48,7 | *3,0* |
| ∑ PUFA (%) | 8,01 | *1,67* | 8,10 | *2,04* | 7,14 | *1,93* | 7,84 | *2,01* | 7,49 | *1,79* |
| ∑ SFA (%) | 41,7 | *2,4* | 41,3 | *3,2* | 41,3 | *2,18* | 40,9 | *2,7* | 41,9 | *2,3* |
| ∑ n-3 (%) | 0,35 | *0,09* | 0,39 | *0,29* | 0,33 | *0,11* | 0,36 | *0,16* | 0,34 | *0,19* |
| ∑ n-6 (%) | 7,73 | *1,69* | 7,67 | *1,95* | 6,81 | *1,87* | 7,48 | *2,05* | 7,15 | *1,74* |
| n-6/n-3 (%) | 24,5 | – | 25,6 | – | 22,5 | – | 24,1 | – | 23,8 | – |

*$^{B,a,c}$Průměry označené stejnými malými písmeny jsou statisticky významné (P < 0,05), resp. průměry označené stejnými velkými písmeny jsou statisticky vysoce významné (P < 0,01).*

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# ŚWINIE POLSKICH RAS RODZIMYCH

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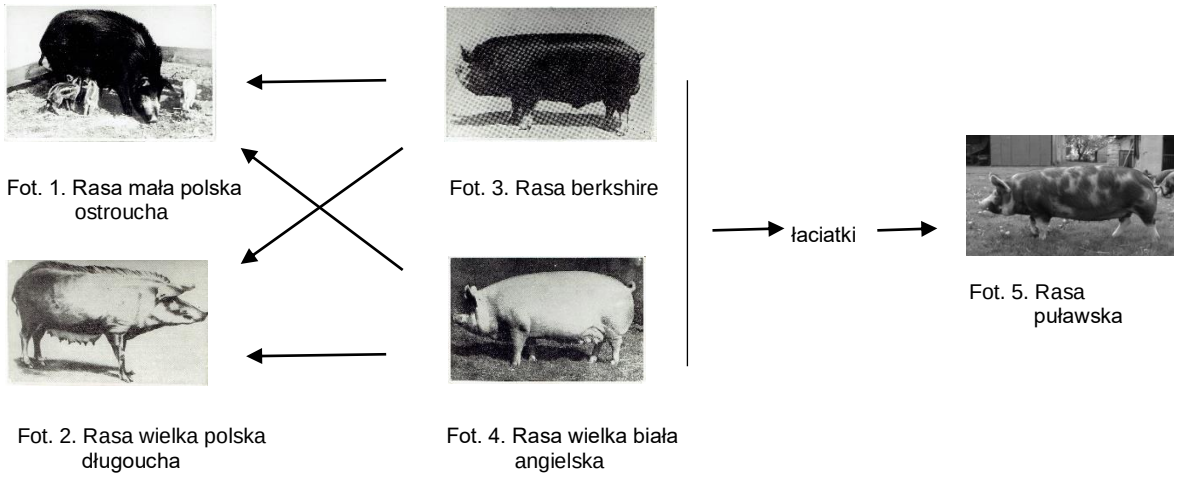
## Wstęp

W Polsce aktualnie użytkuje się świnie trzech ras uznanych jako rodzime. Są to: puławska, złotnicka pstra i złotnicka biała. Powstały one na bazie prymitywnych świń kształtowanych przez środowisko na terenie bytowania. W początkowym okresie w ich powstawaniu brały także udział rasy szlachetne. Najstarszą spośród polskich ras rodzimych jest puławska, która oficjalnie została uznana w roku 1935 - początkowo pod nazwą rasa gołębska. Prace nad kształtowaniem ras złotnickich rozpoczęto później, w latach 1946-1949, a oficjalnie uznano je jako rasy w roku 1962. W tymże roku otwarto dla nich oddzielne (dla złotnickie pstrej i złotnickiej białej) księgi zwierząt hodowlanych. Świnie polskich ras rodzimych pozostają obecnie w stadach hodowli zachowawczej i są objęte Programem Ochrony Zasobów Genetycznych Świń Ras Rodzimych w Polsce. Od roku 2009 świnie rasy puławskiej znajdują się na Liście Produktów Tradycyjnych, która jest prowadzona przez Ministra Rolnictwa i Rozwoju Wsi. Od roku 2006, na tej samej Liście znajduje się wieprzowina pozyskiwana od obu ras złotnickich, pod nazwą „Wielkopolska wieprzowina złotnicka". Cechą wyróżniającą wszystkie rasy rodzime jest produkcja bardzo dobrej jakości, smacznego mięsa.

## Rys historyczny polskich ras rodzimych

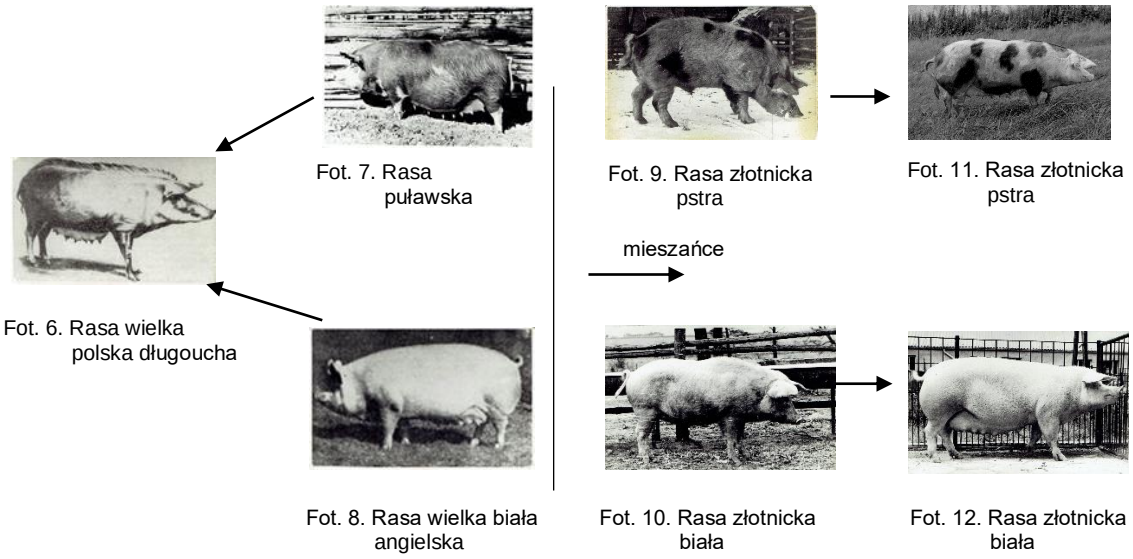
**Rasa puławska** powstała na bazie prymitywnych świń ostrouchych (mała polska ostroucha – fot. 1) i prawdopodobnie świń długouchych (wielka polska długoucha – fot. 2). Miejscem ich bytowania była południowo-wschodnia Polska (tereny Lubelszczyzny) gdzie na przełomie XIX i XX wieku importowano z Anglii nowopowstałe rasy szlachetne, m.in. wielką białą angielską, berkshire. tamworth. W wyniku niekontrolowanych krzyżowań powstała populacja mieszańców niejednolicie umaszczonych, która zyskała nazwę „łaciatek" i stosunkowo szybko zdobyła popularność. Wkrótce stała się przedmiotem zainteresowania hodowców, skupionych wokół prof. Zdzisława Zabielskiego z Państwowego Instytutu Naukowego Gospodarstwa Wiejskiego (PINGW) w Puławach. Efektem zastosowanych prac hodowlanych było uzyskanie zwierząt, które w roku 1935 można było oficjalnie zarejestrować jako oddzielną rasę - najpierw pod nazwą „rasa gołębska" (rok 1935), a później (w roku 1951) pod zmienioną nazwą „puławska". Do charakterystycznych cech ówczesnej rasy puławskiej, można było zaliczyć: wczesne dojrzewanie somatyczne, wyraźnie zaznaczony dymorfizm płciowy, wrodzona odporność i doskonałe przystosowanie do środowiska, w miarę ustabilizowane łaciate umaszczenie (czarno-białe lub czarno-biało-rude), średnia płodność loch (ok. 10 prosiąt w miocie) i bardzo silnie rozwinięty instynkt macierzyński. Należała do typu użytkowego tłuszczowo-mięsnego.

Schemat udziału poszczególnych ras w kształtowaniu rasy gołębskiej/puławskiej, przedstawiono na ryc. 1.




Ryc. 1. Schematyczne ujęcie powstawania rasy puławskiej
(fot. zasoby własne; IZ Kraków)

**Rasy złotnickie** wiążą się z Regionem Wielkopolski, a także Warmii i Mazur (byłe województwo olsztyńskie). Wywodzą się od prymitywnych świń długouchych (wielka polska długoucha – fot. 2, 6), a także w mniejszym stopniu od świń krótkouchych. W ich późniejszym kształtowaniu brały prawdopodobnie udział (poprzez jednorazowe dolewy krwi, rasy wielka biała angielska i puławska). Prace hodowlane w kierunku wytworzenia ras złotnickich prowadzone były pod nadzorem prof. Stefana Alexandrowicza z ówczesnej Wyższej Szkoły Rolniczej w Poznaniu (obecnie Uniwersytet Przyrodniczy). Punktem wyjścia były mieszańce zakupione od przesiedleńców na teren Warmii ze wschodnich kresów przedwojennej Polski. Umieszczono je, celem dalszego wykorzystania w pracach hodowlanych, w Rolniczym Zakładzie Doświadczalnym Złotniki. Ich doskonalenie opierało się głównie o ukierunkowaną selekcję na najważniejsze cechy gospodarcze. Wyodrębniono dwie odmiany ras złotnickich – białą, o umaszczeniu białym i podwyższonych cechach mięsności oraz pstrą, o umaszczeniu niejednolitym i bardziej zaznaczonych cechach otłuszczania. Później przekształcono je w samodzielne rasy. Do najważniejszych cech charakteryzujących rasy złotnickie należałoby zaliczyć: późne dojrzewanie cielesne, doskonałe przystosowanie do środowiska, średnie tempo wzrostu, wysoką aktywność płciową knurów, średnią płodność, na poziomie ok. 10 prosiąt w miocie. Lochy złotnickie charakteryzują się wysokim instynktem macierzyńskim i dobrą mlecznością, przy czym bardziej płodne (o ok. 1 prosię) są lochy rasy złotnickiej białej. Osobniki rasy złotnickiej białej wykazują także większe zdolności mięsotwórcze (są w typie mięsnym). Zilustrowany schemat kształtowania ras złotnickich przedstawia ryc. 2.




Ryc. 2. Schematyczne ujęcie powstawania ras złotnickich (fot. zasoby własne)

**Aktualny stan hodowli i produkcyjność polskich ras rodzimych**

Stan liczebny oraz niektóre wskaźniki produkcyjności loch i knurków ras rodzimych zestawiono w tabeli 1. Dla porównania pokazano także wartości odpowiednich cech, najliczniej reprezentowanej w polskiej hodowli rasy polskiej białej zwisłouchej. Ogólna liczba loch objętych kontrolą w Polsce, w roku 2016 wynosiła **10 900 szt.**

Tabela 1. Liczba loch i knurków objętych kontrolą użytkowości oraz niektóre wskaźniki produkcyjne uzyskane w roku 2016

| Wyszczególnienie | Rasa | | | |
|---|---|---|---|---|
| | puławska | złotnicka pstra | złotnicka biała | pbz |
| 1. Liczba loch, n | 1139 | 508 | 848 | 4511 |
| 2. Użytkowość rozpłodowa loch | | | | |
| - liczba ocenianych miotów | 1876 | 636 | 1316 | 10888 |
| - liczba prosiąt żywo urodzonych | 10,57 | 9,16 | 9,54 | 12,02 |
| - liczba prosiąt w 21 dniu | 9,42 | 8,08 | 8,67 | 11,08 |
| - wiek pierwszego oprosienia, dni | 365 | 414 | 456 | 351 |
| 3. Średnie wyniki oceny przyżyciowej knurków | | | | |
| - liczba ocenianych knurków | 786 | 4 | 19 | 3584 |
| - przyrost dzienny, g | 576 | 437 | 462 | 714 |
| - średnia grubość słoniny, mm | 14,9 | 15,4 | 15,6 | 9,1 |
| - zawartość mięsa w ciele, % | 53,5 | 51,6 | 51,9 | 60,1 |

Najbardziej liczną rasą spośród polskich ras rodzimych jest rasa puławska. Wzrost liczebności loch zarodowych świń puławskich i złotnickich jest w Polsce tendencją zauważalną od pewnego czasu, która trwa do dnia dzisiejszego. Produkcyjność loch użytkowanych w roku 2016 (podobnie jak w latach poprzednich) była wyraźnie niższa w porównaniu do najbardziej liczebnej rasy polskiej białej zwisłouchej. Płodność loch rasy puławskiej była znacząco wyższa niżeli ras złotnickich. Wyraźnie wcześniej rodziły także pierwsze mioty, co może świadczyć o jej wcześniejszym dojrzewaniu. Podobne tendencje związane z porównaniem ras wystąpiły w odniesieniu do cech oceny przyżyciowej młodych knurków.

**Jakość mięsa świń ras rodzimych w świetle badań własnych**

Wartości wybranych cech oceny jakości mięsa pokazano w tabeli 2. Dla porównania zamieszczono także wyniki komercyjnych mieszańców czterorasowych (wielka biała polska, polska biała zwisłoucha, pietrain i duroc). W zdecydowanej większości przypadków wyniki kształtowały się korzystniej u ras rodzimych. Porównanie wyników rasy puławskiej i złotnickiej pstrej nie wykazało wyraźnej przewagi jednej z nich. Zwraca uwagę wysoka zawartość tłuszczu śródmięśniowego (szczególnie u puławskiej). Potwierdza to m.in. uznaną opinię o lepszej jakości i smakowitości mięsa świń rasy puławskiej i ras złotnickich.

Tabela 2. Wartości wybranych cech jakości mięsa (badania własne)

| Wyszczególnienie | Rasa | | |
|---|---|---|---|
| | puławska | złotnicka pstra | (wbp x pbz) x (d x p) |
| Swobodny wyciek soku, % | 2,26$^{A}$ | 2,95$^{A}$ | 4,57$^{B}$ |
| Wyciek termiczny, % | 24,89$^{B}$ | 21,80$^{A}$ | 28,42$^{C}$ |
| *L** | 52,86$^{B}$ | 49,19$^{A}$ | 53,13$^{B}$ |
| *a** | 15,97$^{B}$ | 17,45$^{C}$ | 15,02$^{A}$ |
| *b** | 3,53$^{Bb}$ | 2,66$^{a}$ | 2,40$^{A}$ |
| Zawartość białka, % | 23,67$^{A}$ | 25,23$^{B}$ | 23,39$^{A}$ |
| Zawartość tłuszczu, IMF, % | 4,07$^{B}$ | 2,25$^{A}$ | 1,70$^{A}$ |
| Zawartość kwasów tłuszczowych, % | | | |
| - SFA, % | 37,79 | 37,20 | 37,49 |
| - MUFA, % | 52,72$^{B}$ | 47,37$^{A}$ | 45,55$^{A}$ |
| - PUFA, % | 9,32$^{A}$ | 15,19$^{B}$ | 16,77$^{B}$ |
| - PUFA n-3, % | 0,97$^{A}$ | 1,06$^{A}$ | 1,71$^{B}$ |
| - PUFA n-6, % | 8,35$^{A}$ | 14,13$^{A}$ | 15,06$^{B}$ |
| - PUFA n-6/PUFA n-3 | 8,79$^{A}$ | 13,39$^{B}$ | 8,88$^{A}$ |
| Zn, mg/kg | 47,12$^{B}$ | 49,79$^{B}$ | 25,70$^{A}$ |
| Fe, mg/kg | 30,08$^{Ba}$ | 40,03$^{Bb}$ | 13,26$^{A}$ |

*A, B - różnice istotne statystycznie przy P<0,01, a, b – różnice istotne statystycznie przy P<0,05*

# UTILIZATION OF INDIGENOUS PIGS IN CROATIA - AN EXAMPLE OF BLACK SLAVONIAN PIG

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**SUMMARY** - Black Slavonian (BS) pig is an autochthonous Croatian breed created in the second half of the 19th century. Until the 1950s it was the most widespread breed in the Slavonia, mainly used for the production of fat and meat products. However, with the transition from extensive to intensive pig farming, its population drastically reduced and in the 1990s the survival of the breed was endangered. However, due to undertaken protection measures and renewed interest for its meat and products, the BS pig population in recent years significantly increased; in 2017 there were 242 boars and 1930 sows. The breed is well adapted for outdoor keeping. Traditional production includes the utilization of pasture and woodland with a supplement of a small amount of grains. Litter size of the breed is low, on average 7-8 piglets. The fattening abilities are also modest, with low daily gains and a high share of fat in the carcass (>40%). However, the meat quality is good, with a high intramuscular fat (6-7%) content and very good aptitude for processing into traditional meat products (e.g. Slavonian kulen, ham, bacon), which are highly appreciated by consumers.

**Key words**: pigs, breeds, Black Slavonian pig, production traits

## ORIGIN, POPULATION, AND TRADITIONAL PRODUCTION SYSTEM

Black Slavonian (BS) pig is an autochthonous Croatian breed developed in the east of Croatia (Slavonia region) by Count Pfeiffer at the end of the 19$^{th}$ century. The breed was originated by crossing Berkshire boars and Black Mangalitsa sows, and later by crossing crossbred females with Poland China boars. In the past, the breed was commonly used for the production of traditional meat products, like famous Slavonian kulen, a slowly fermented and dried spicy sausage stuffed in pork blind gut. Until the middle of 20$^{th}$ century, BS was the most widespread breed in the Slavonia, mainly used for the production of fat and meat products. However, by importing modern white pig breeds, the population of BS pig was drastically reduced. In 1996, the size of the effective population was less than 20 and survival of the breed was endangered (Uremović *et al*., 2000). The same year, Croatia signed the Biodiversity Treaty (CBD, 1992) and "A Survey of the State of Biological and Environmental Diversity of Croatia with Strategy and Protection Plan Action" was elaborated (DUZZP RH, 1999), as well as "A Program for Breeding up of the Black Slavonian Breed" (Uremović and Janeš, 2000). As a result of undertaken measures and state subsidies, a reduction in the number of BS pigs was stopped. In recent years, due to the increased interest for its meat products, effective population of BS pigs significantly increased. Currently, the breeding population consists 242 boars and 1930 sows kept at 225 farms. Traditional BS pig production is an outdoor, grazing system which includes utilization of natural resources of pasture and oak (*Quercus robur L*.) woodland with supplement a small amount of corn seed or some other grains (~ 0.15 kg per head daily). Together with pasture, pigs consume foodstuff found on stubbles after the cereals (wheat, corn, and barley) have been harvested. The sows are conventionally kept in pens for farrowing littered with straw in eaves closed on three sides, one week before farrowing and after farrowing to weaning. There are on average 1.5 farrowing per year. During low temperatures, piglets may be heated (i.e. with infra-

red lamps). After the weaning, sows and piglets are kept in the open with the possibility of entering eaves. Usually, there are about twenty sows per ha. During rough winter months, the animals may also be kept inside piggery in the villages. The short period of pre-slaughter fattening with concentrated feed is common. In general, the breed is well adapted for outdoor keeping in conditions of continental climate due to its pronounced resistance, pigmented skin and ability to consume large amounts of pasture (Uremović *et al*., 2003; Senčić *et al*., 2005).

## PRODUCTION TRAITS

Production traits of BS breed have not been sufficiently investigated. However, as for most of the local autochthonous breeds, the production traits are rather limited. Uremović *at al*. (2000) found that an average number of liveborn and reared piglets per litter was 6.89 and 5.76, respectively. The fattening abilities are also modest. Under extensive conditions of fattening, the daily gain in body mass starting at 27.20 kg and reaching 106.05 kg was 478 g, with low meat percentage in the carcass (42.95 %) (Uremović *et al*., 2000). In a few previous papers, even lower meatiness in the carcasses of similar weight (~80 kg) was reported: 28.59 % (Petričević *et al*., 1988) and 28.51 % (Kralik *et al*., 1988). In general, Black Slavonian pigs are characterized by high proportion of adipose tissue in the carcass. For example, in heavy Black Slavonian fatteners (in the age of about 18 months and average body weight of 160 kg) used for the processing of Slavonian Kulen sausage, the average depth of meat and fat above *m.gluteus* were nearly the same, 64 and 63 mm, respectively. While in the carcasses of crossed white pigs (Large White x Swedish Landrace sired with Duroc) of similar age and weight the average depth of meat and fat were 73 and 30 mm, respectively. As a consequence, in comparison to modern white crosses, BS pigs have significantly lower utilization of primal cuts (hams, back, shoulders and neck) (32.33 vs. 26.75 %, $P<0.05$) and lower utilization of carcass (19.85 vs.16.26 %, $P<0.05$) for the production of traditional products like Slavonian kulen (Karolyi *et al*., 2004). These results, however, were obtained after the prolonged period of pre-slaughter fattening in the piggery when weight gain of pigs is mostly due to the accumulation of fat. Results from traditional outdoor-low input system, reported by Senčić *et a*l. (2005), showed practically the same shares of fat and muscle tissue (40.96 and 41.00 %, respectively) in the carcasses of BS pigs reared until 12 months of age and average body weight of 130 kg. In the same experiment, significant improvements in the carcass meatiness were obtained by crossing BS pig with Swedish Landrace boars (in F1 progeny the share of fat and muscle were 36.03 and 44.59 %, respectively).

## MEAT QUALITY

Regarding meat quality traits, no prominent defects in the meat from BS pigs were reported. The $pH_i$ and $pH_u$ values of *m.longissimus dorsi* were inside the normal scope and ranged between 6.11-6.60 and 5.80-5.87, respectively (Karolyi *et a*l., 2004, Senčić *et al*., 2005; Karolyi *et al*., 2007). The meat of BS pigs is visually darker and redder than the meat from modern pigs. The lightness (Cie *L**) and redness (Cie *a**) values of longissimus muscle colour were 49.93 and 20.02, respectively (Karolyi *et al*., 2004). The water holding ability was 4.50 $cm^2$ (Senčić *et al*., 2005). The most distinctive characteristic of meat of BS breed in comparison to pork from modern pig breeds is the particularly high content of intramuscular fat (IMF), in average 6 to 7 % (Uremović *et al*., 2004; Senčić *et al*., 2005; Karolyi *et al*., 2007). Intramuscular fat influences juiciness, flavour, tenderness and visual characteristics of meat (Miller, 2002). The optimal level of IMF for pork is generally considered between 2.5-3.0 % (Grebens, 2004), while low IMF

content may impair chewing properties of meat. However, the excessively high content of IMF (>6 %) makes fat in the meat become too visible which may avert the consumer (Resurreccion, 2003; Miller, 2002). It is well known that industrial pork, in general, has an unacceptably high ratio of n-6 and n-3 polyunsaturated fatty acids (Wood et al., 2003). The n-6/n-3 index is particularly high if animals were intensively fed with concentrated feeds because the cereals are rich in linoleic acid (C18:2n-6). The influence of feedstuff in the traditional feeding system of BS pigs, which includes utilization of the natural resources of pasture and oak, on the fatty acid profile of meat has been investigated by Karolyi at al. (2007). The indication of beneficial effects of oak (*Quercus robur L*.) was found when Black Slavonian pigs were fed with acorn or with concentrate feed during pre-slaughter fattening. Feeding acorn ad libitum three weeks before slaughter significantly increased the content of alpha linolenic acid (C18:3 n-3) in the longissimus muscle in comparison to concentrate fed group (0.37 vs. 0.12, respectively; expressed as % of total fatty acid methyl esters, $P<0.01$). As consequence, the n-6/n-3 ratio in the muscle of acorn finishing pigs was nearly threefold lower than in concentrate finishing pigs (24.1 vs. 69.3, $P\leq0.01$).

## MEAT PRODUCTS

Traditional Slavonian meat products have their origin in the time of family cooperatives and the existence of homes (granges) located on pastures near the woods, on which pigs and other cattle were bred (Petričević et al., 2002). The early beginnings of development of such farming agricultural system on Slavonian-Srijem area are connected to formation of the Military Border in the 17$^{th}$ century, when the pigs, except for subsistent needs, started to be bred on a large scale for the needs of the army and larger consumer centres of Austrian-Hungarian Monarchy (Benčević and Petričević, 1999). The purpose of pig breeding was for a long time intended primary for the production of bacon and fat, which were, at the time, the most wanted products. Later, with improvement of breeding and feeding of pigs, especially at manorial estates, and with growing development of butcher's trade, some other autochthonous products such as Slavonian kulen, ham, bacon and sausages were developed, whose tradition of production in Slavonia region has been preserved to these days (Benčević and Petričević, 1999). Of the pig breeds bred at that time in Slavonia, Benčević and Čakalić (2001) mention Croatian Šiška as the oldest breed, then Bagun and Mangalitsa, and finally, BS breed of pigs, which was around the middle of the 20$^{th}$ century the most numerous breed in Slavonia greatly used for the production of fat and traditional meat products. But in following decades, with the rapid introduction of industrial pig production and leaner pig breed genotypes, the BS breed become rare, as it was largely replaced by more productive white pig breeds and crossbreeds. However, within the current trends of promotion and support of sustainable traditional systems of food production, and increased interest for traditional foods from consumers across Europe, it becomes more important to preserve traditional production systems of local breeds and their products. In that sense, renew of breeding of BS pigs for the production of traditional meat products of added value has become justified in recent years (Ekert Kabalin et al., 2007; Karolyi et al., 2007). Among traditional Slavonian meat products, the most prominent position as before so now belongs to Slavonian kulen (or Slavonian kulin), which has remained a constituent part of the tradition, food culture and the way of living in Slavonia (Kovačić, 2005). Technologically, it is a dry-cured sausage produced of a mixture of pork meat and back fat of the best quality, which is minced and mixed with the addition of table salt and natural spices (hot and sweet pepper and garlic), and stuffed in pork blind gut (*caecum*). Slavonian kulen is then cold smoked, and it naturally ferments, dries and ripens during several months. Ripe Slavonian kulen can be characterized as a

long-life dry sausage of low acidity (high pH), whose microbiological stability and sustainability are conditioned by low activity of water (aw) in a finished product (Karolyi et al., 2005; Karolyi 2011). During the process of Slavonian kulen production under certain conditions of temperature, moisture and circulation of air, the stuffing undergoes complex physical-chemical and enzymatic changes of carbohydrates, proteins, and fats, loss of water and increase in the concentration of dry matter. These changes, along with the quality of raw materials and spices, are very significant for final quality, nutritional and organoleptic traits of Slavonian kulen.

## CONCLUSIONS

It could be concluded that *in-situ* conservation of local BS breed so far has been successful. However, the long term re-establishment of the population of BS breed must be considered on an economical basis. As a part of current trends of support for sustainable and traditional food production systems, it becomes important to preserve the traditional production of meat products from local breeds. In this way, it is reasonable to start breeding the BS pigs again for the production of Slavonian Kulen and other value added artisan meat products (e.g. ham, fat, bacon etc.) increasingly demanded by nowadays markets. This is, by itself, without the doubts, the best way for the long-term preservation of BS and similar economically still untapped local pig breeds.

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# ECONOMIC EVALUATION OF BEEKEEPING AND BOTANICAL ORIGIN OF CROATIAN HONEY TYPES

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In the Republic of Croatia, apiculture is a traditional branch of agriculture. In many countries, indigenous breeds of bees are on the verge of extinction due to crossing with other breeds. In the Republic of Croatia, the autochthonous breed Carniolan honey bee (*Apis mellifera carnica* Pollman, 1879) has been preserved until today. It is known for its calmness, diligence and good orientation in space. These qualities make the Carniolan honey bee highly valued and very important in agriculture, forestry and ecosystem sustainability.

Apiculture has great economic importance in the Republic of Croatia. Honey bee products – honey, pollen, wax, propolis, royal jelly and bee venom are used as food and dietary supplements, due to their functional properties as remedies for health problems. Honey bee products are therefore highly important for the production of food and other products. The total value of all honey bee products is significantly lower than the importance and benefit of plant pollination.

According to the data there are 12 500 beekeepers and around 550 000 honeybee colonies. As regards local honey production, depending on the nectar flow conditions of respective year, it's in the range from 6 410 to 8 000 t. Beekeeping production in Croatia is exclusively organized by family households and the production is measured by the amount of honey produced. There are three categories of beekeepers: hobby beekeepers, full-time beekeepers and part-time beekeepers. Most of them are part–time beekeepers with less than 60 beehives (53-55 %), hobby beekeepers with 61-150 beehives comprise 35-37 % and professional beekeepers with more than 150 beehives represent the smallest part with 9-11 %. In generally, average yield per bee hive for hobby beekeepers is less than 25 kg, part–time beekeepers 30-35 kg, and professional beekeepers moore than 40 kg. Most of the income beekeepers generate from selling a honey. Other bee products, such as pollen, wax, propolis, package bees, have marginal contribution to total income.

The beekeepers are usually oriented on production of honey, but they generate extra income from other products as well. This extra income is 20-25 € per beehive for a hobby beekeepers, 12-16 € part–time beekeepers, and 20-22 € for professional beekeepers. Beside the highest production expenses (60-70 €) hobby beekeepers have the highest total income 150-170 € per hive. Main reason is their higher selling price through direct selling.

Beekeeping production is mainly organized on family farms. “Small scale” beekeepers represent more than 75 % of the total number of beekeepers in Croatia and about 25 % of total number of bee hives. Only about one third of beekeepers migrate their hives. The marketing of honey products is not well organized and the honey consumption per citizen is low.

Croatia has favourable conditions and long tradition in apiculture, particularly for honey production. In honey production process, besides the beekeeper and high quality of honey bee breed, an important factor for the preparation of the product for the market, is the evaluation of specific area's natural potentials.

The term natural potentials primarily refers to floristic composition and climate conditions that greatly influence honey type variability. Geographical position of

Croatia is specific and the territory spreads over three different regions: Pannonian, Mountain and Adriatic region.

Each region has specific climate and vegetation. Biodiversity of a nectar flow plant species from different climatic and geographical areas of three distinctive Croatian regions provides a great potential for the production of a common, but also a specific, rare and unique unifloral honey types.

Three honey types from the Pannonian region of Croatia, black locust, (*Robinia pseudoacacia* L.), lime (*Tilia* spp.) and sweet chestnut (*Castanea sativa* Mill.) honey, are withal the most represented on the Croatian market. Black locust honey is producing in the highest amounts and it is followed by sweet chestnut and then lime honey.

After the main types of honey, other honey types are also producing in this area, such as rapeseed (*Brassica napus* L. var. o*leifera*) and sunflower (*Helianthus annuus* L.). However, a special attention should be given to allochthonous plant species, False indigo (*Amorpha fruticosa* L.) and Giant goldenrod (*Solidago gigantea* Aiton), which have expanded so much that in some years, in case of favorable weather conditions for nectar flow, it is possible to produce significant quantities of these honeys.

According to the literature on European unifloral honey types, a mint honey belongs to a rare honey types. In the area of a Nature Park called Lonjsko field, a substantial part of the flooded areas are wet meadows and pastures on which two kinds of mint grow: Water mint (*Mentha aquatica* L.) and Pennyroyal mint (*M. pulegium* L.). Occasionally, it is possible to produce unifloral Willow (*Salix* spp), the Common ivy (L.) and Himalayan balsam (*Impatiens glandulifera* Royal) honey in that region.

Within the group of honeydew honey types, we can emphasis oak, willow and then honeydew honey of unknown origin. Also, occasionally, honeydew appears on sweet chesnut and lime. In Požega valley an area of the Hungarian oak (*Quercus frainetto* Ten.) is recognized as a specific source of honeydew. The beekeepers from Požega region have recorded that honey bees readily collect the plant sap on oak. Oak nut sap starts to flow over cuticle often with the foam appearance. Probably the physiological process of the plant induces the appearance of this specific honeydew.

In mountain region, within the group of unifloral honeys, it is possible to produce lime (*Tilia* spp.) and (*Dorycnium* spp.) honey in this region. In addition to the listed species, it is occasionally possible to produce White melilot (*Melilotus albus* Medik.) honey, as well as Heather (*Calluna vulgaris* L.) honey. An interesting detail in this area is that this is an area of mountain meadows and it is therefore possible to produce meadow honey. Suggestion is that if the share of meadow plant species is more then 60% the honey could be declared as meadow honey, which differs from floral honey.

Aside the above-mentioned nectar honey types, the production of coniferous honeydew honey of fir (*Abies alba* Mill.) and spruce (*Picea abies* L.) is also very important in Mountain region because the largest areas of fir and spruce lie there.

It is known that sage (*Salvia officinalis* L.) cannot be found on such large areas amongst the native flora in any of the Mediterannian countries, as in Croatian Adriatic region.

In the Adriatic region, aside from sage honey, throughout the littoral zone and on islands, it is possible to produce Christ thorn honey (*Paliurus spina- christi* Mill.). In the inside part of Adriatic region, there are interesting areas under Mountain Savory (*Satureja montana* L.). A special attention should be also given to the heath trio led

by the Tree heath (*Erica arborea* L.), Mediterranean heath *(E. multiflora* L.) and Autumn heath (*E. manipuliflora* Salsib.), according to their distribution. In this region there is also a possibility for limited local production of mandarin honey (*Citrus unshiu* Marc.). On the world market, mostly, other citrus species are represented (lemon and orange), while a smaller part is represented by mandarin honey. Therefore, almsost monoculture plantations of mandarin in Croatia (estimated on 1 500 ha), in the Neretva river delta, should be taken as advantage for mandarin honey production.

There are also few honey types which production is limited due to the specific, but restricted floral areas of Adriatic region from which they can be collected, and these are: rosemary (*Rosmarinus officinalis* L.), lavender (*Lavandula* spp.), strawberry tree (*Arbutus unedo* L.) and immortelle (*Helichrysum italicum* L.). In recent years, honeydew occurs in the Adriatic region more frequently then usual. But its origin is unknown.

In the field of protection of indigenous agricultural and alimentary products so far are protected two county brands („Bagremov med zagorskih brega“ i „Slatka nit“) and on a EU level Protected Designation of Origin is „Slavonski med“. Also protection of „Istarski med“, „Goranski medun“, „Dalmatinski med“ and „Zagorski bagremov med“ are in preparation.

According to the botanical origin, it is possible to produce in total 30 nectar honey types and 10 types of honeydew honey. Specifically, 14 nectar honey types can be produced in Pannonian region, 4 in Mountain region and 12 in Adriatic region. With respect to honeydew honey, it is possible to produce the highest number of different types (6) in the Pannonian region, which is followed by 2 types of honeydew honey frequently occurring in the Mountain region, and 2 in the Adriatic region.

# BEEKEEPING IN SLOVAKIA – SITUATION IN 2017

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## Natural conditions of beekeeping

Since times immemorial, bees and their products have been known on the territory of Slovakia. First written evidences on honey and mead (honey-wine) from our territory come from 5th century by Byzantine philosopher Priscus. At first our ancestors used to steal honey from the wild bees living in the trunks of trees, but in 12th century bees began to be kept in households. People used honey and wax to pay taxes. Rational beekeeping actually started in the late 18th century, new hive designs and movable frames were adopted in the second half of the 19th century. Antique hives, many of which are shaped into forms of saints, bears or other motives and painted, skeps, bee houses, wax presses and traditional equipment can still be admired today in the beekeeping exhibitions at Kralova pri Senci, Nitra, Martin and other open-air museums.

Motley and rich sources of bee forage allow efficient beekeeping in most areas, which totals 49,035 sq km. The climate is moderate and does not exceed, even in the mountain regions, in hard winter, the limits bearable for beekeeping. As a rule, the spring comes as soon as early March and the sunny autumn extends until the end of October. The landscape in the Slovak republic is quite rugged – lowlands, hills and high mountains ranges often lie close to each other. Therefore Slovak honeys are usually mixed. Most hives are concentrated in the southern part of Slovakia. Growth rates are dependent upon important nectar and pollen sources, such as willows, fruit trees, and most importantly, rape. At the end of this initial blossoming season the black locust (acacia) begins blooming. In summertime pollen and nectar originate from limes, sunflowers and meadows. In the northern part of Slovakia the coniferous honeydew is found, especially on spruce and fir. Dark forest honeys produced here are very asked on inland and international markets. Up to 41% of the territory is covered by forests, where also other nectar sources can be found including raspberries, bilberries, blueberries and meadow herbs.

## Breeding work

The most significant race of bees is the Carniolan bee (Apis mellifera carnica) of Carpathian type. This race is autochthonous on the territory of Slovakia, and is popular for good wintering, quick spring growth and calmness. The importation of other races of honeybees is not allowed. Throughout the country, there are 70 registered queen producers, which are producing cca 8000 queens annually. Price vary from 15 to 30 € per queen. Selection is performed in 8 registered breeding stations. Mostly they belong to 7 Slovakian lines of Carniolan bee, but importation of some Austrian, Slovenian, Czech and Ukrainian Carniolan lines is visible within the last years (f.e. Sklenar or Singer) – officially 350 annualy. By appropriate selection and breeding, breeders are determined to select bee colonies that are less inclined to swarm and show inherent resistance against the Varroa mite. Unfortunately, a lot of beekeepers, especially hobby ones, misapprehended the role of high quality queens and use their own production, instead of purchased from distinguished breeders. Artificial insemination of queens is practised, but usually mainly for breeding purposes.

## Health situation

The biggest health problem is the Varroa mite. We use combination of several drugs to keep the mite level in hives on acceptable level. During honey-flowing season mainly evaporation of formic acid is practised, to a lesser extent trickling or sublimation of oxalic acids, trickling by VarroMed (HiveClean) or using thymol and other essential oils carriers, including Thymovar, Apiguard, Apilife Var and from 2017 also Russian product Ekopol. The other medicines containing synthetic acaricides are used after last honey harvest to do not contaminate honey products. Application methods include fumigation (amitraz based preparations Avartin 01 B-90 and Varidol Fum) or contact applications Gabon PF 90 strips based on fluvalinate, or Bayvarol (resp. Polyvar Yellow) based on flumethrine. Winter treatment of colonies is promoted among beekeepers to eliminate Varroa in broodless colonies which seems to be very efficient measure to eliminate winter colony losses. Aerosol applicators Vat or Furetto are used to apply amitraz into hives when outside temperatures reaches from +10 to -5°C, usually in December. Amitraz, at least once per year, is used by 88 % of beekeepers, formic acid short evaporation by 45 %, fluvalinate by 34 % and VarroMed by 30 % of all beekeepers. Beekeepers usually use a minimum 2 various chemical products for Varroa control per year.

Every year several outbreaks of American foulbrood appears, those apiaries are isolated, in the regions transhumance is not allowed and infected hives and wood inventory is usually burned.

Chalkbrood, nosematosis (including Nosema ceranae) and viral diseases (sacbrood, DWV, ABPV, SBV, KBV) causing also problems in some apiaries.

Main bee predators are wax moth, ants, mouse and bears. Around 1500 brown bears live in Slovakia. Even it is protected species, sometimes causes damages to sheep's herds, gardens and hives. Winter colony losses during last 8 wintering seasons were under 10 %, in the winter 2017/2018 has crossed this limit for the first time and reached 13 %.

## The hives and apiaries

Until recently many different types of hives were used in Slovakia. Currently there is a growing use of unified types of hives. Most common frame sizes are 420 x 275 mm (around 60 %) or 370 x 300 mm (cca 13 %). These hives are usually double walled and insulated. The reason should be that we are still as emotionally attached to bees as our ancestors and we wish them to have dry, warm hives protected against bad weather. Multi-storey simple walled hives of Langstroth type are increasingly popular. Commercially oriented beekeepers that keep their colonies in bee yards or in mobile trucks engage in migratory beekeeping. Colonies are fairly equally distributed throughout the country, which enables good pollination of cultivated and wild plants and thus it is not necessary for many beekeepers to migrate to fruit plantations or larger crops of rape and sunflower. Today, beekeepers mostly transport their bees to rape, black locust plantations and late fir and spruce forest forage. More than a quarter of Slovakia is under nature protection, so many beekeepers meet requirements for organic production, but only one with 400 hives is yet registered as bio-honey producer. The main reason for this low number is complicated certification and controlling process together with stagnating prices for organic honey.

## Beekeeping organizations, research and education

In 1869 the first beekeeper's organization in the territory of Slovakia, The Slovak Association of Beekeepers in Upper Hungary, was created. After many organizational changes, beekeepers today are organized into the Slovak Association of Beekeepers established in 1957 (about 80 % of organized apiarists), since 1990 also into the Union of Beekeepers in Slovakia and since 2017 in the Association of Beekeepers. Another 7 beekeeping organisations carry out their activities, but each represents just a few beekeepers. Queen breeders are organised in Slovak Association of Carniolan bee breeders and fans of Langstroth type hives in the Working group of lower-suppers beekeepers. The biggest monthly magazine is "Vcelar" ("The Beekeeper"), issued by the Slovak Association of Beekeepers in Bratislava. The Slovak Association of Beekeepers is a member of Apimondia, Apislavia, BeeLife, V4 Beekeeping Action Group and EPBA (European Professional Beekeepers Association) organisations.

In the north of the country, in a small town Liptovsky Hradok, is situated the Research Institute of Beekeeping. Together with the University of Agriculture in Nitra, University of Veterinary medicine in Kosice and Slovak Academy of Sciences in Bratislava this Institute coordinates the plans, research activities, insemination of queens, gene mapping and other selected beekeeping and research programs.

Trainings of beekeepers are organised on demand, systematic schedule of regular and advanced trainings exists. Presentations, courses and seminars represent the broadest form of training while they are organized by local organisational parts of the Slovak Association of Beekeepers, which are actually 150. From 2009 there is a possibility to study beekeeping specialization in two-year course on the High School in Banska Bystrica. Courses of beekeeping are available also for students at the Agricultural University, at both schools experimental and training apiaries are available. Several titles of books, leaflets and other educational papers are issued yearly.

## Structure of beekeeping sector

In the years 1990 – 2007 the clear trend has been a reduction in the number of bee colonies. Today the number of colonies is stabilised, actual number (year 2017) is 267 000, while as recently as 1989 the number was 430 000. More than 20 000 beekeepers have stopped-keeping bees as a hobby since the "Velvet Revolution" in 1989. The reason was disappearing of state and cooperative farms, adopting free trade economy principles, decline of governmental financial subsidy, price decline of bee products, bee diseases and lack of interests of young people to continue with hobby of their fathers. Current status (year 2017) is about 17 400 beekeepers, keeping an average of 15 hives. Nevertheless, in comparison with statistical surveys of some other European countries, our situation is not the worst. We still have closely 8 bee colonies per sq km.

Beekeepers in Slovakia are a rather heterogeneous group. Many people without agricultural education and heritage have found an interest in keeping bees. There are three main subgroups among Slovakian beekeepers: hobbyist, part-time and full-time beekeepers. Hobby beekeepers are involved in beekeeping because they treat is as free-time activity or they simply like it. Approximately 80 % of all apiarists keep less than 20 colonies each. Their main product is honey sold or gifted to relatives or neighbours directly. Part-time beekeepers keep usually 21-150 hives and are retired or they have second job. They represent around 20 % of all beekeepers. Just 60 are professional ones, keeping more than 150 colonies. They represents only 0,3 % of all

beekeepers but operate 4,2 % of Slovakian bee colonies. Full times beekeepers move their hives regularly and intensively to increase honey yield.

The major part of beekeepers is retired and disinterest of youngsters in beekeeping remains as a main problem for the future. There is also no tradition in building apiaries with high concentration of colonies. During the era of socialism was donated beekeeping as a hobby activity with the philosophy to have colonies equally distributed around the country to ensure pollination even in less favourable climatic areas. Low wholesale and retail prices together with honey/sugar parity, increasing prices of entries and disease situation are the most important issues of low profitability of some local apiarists. Beekeepers are disenchanted for benevolent European legislative according to honey quality and low-price honey import from third countries. The protection label named “Slovakian honey” owned by the Slovak Association of Beekeepers was thus introduced to keep the excellent reputation of Slovak honey. Labelling using this protection mark provides consumer with an extraordinary guarantee that it is produced by local beekeepers, is not adulterated and achieves higher qualitative parameters comparing with common honey legislative (f.e. water content less than 18 % or HMF less than 20 mg/kg).

**Marketing**

The long-term average annual yield is from 10 to 30 kg of honey per colony, in good areas of southern Slovakia yields from 40 to 80 kg per colony can be reached. Slovakia in the total number of hives in the EU contributes about 2 % and produces around 1,8 % of honey, which is more than territorial share (1,2 % of the EU territory). Part of the honey yield is used by beekeepers in their households or is sold directly to consumers. Wholesale prices today for 1 kg of honey ranges around 2,5 €, retail prices ranges from 5 to 8 €. Direct price producer – consumer is usually 6 – 7 €.

Main portion of honeys offered on market are multifloral honeys, from unifloral ones are frequent black locust, rape, suflower, tilia (lime-tree) and dark forest honeys, but also raspberry, chestnut, phacelia and other honeys can be found.

Consumption of honey per capita in Slovakia raised up to 1,2 kg per capita (year 2017), but is hard to count it, as probably around 50 % of the production is sold directly to the consumers by beekeepers. This practise of “selling from the window” is now legal if the beekeeper sells their own honey harvest only and jars are labelled. During Christmas honey is irremissibly on every holiday table, but after winter period demand is decreasing. On the market the honey is sold in various packages. A honey wine – mead, has increasing popularity on inland market, this product is popular as a traditional sweet mead or metheglin – mead flavoured by herbs or spiced. Slovak meads were awarded at all 7 World Honey Contest organised by Apimondia as well as International Mead Contests Mazer Cup.

Other industrial honey products are gingerbread, sweets, cereal bars, nuts with honey, and other products. At various exhibitions attractive honey pastries of various shapes and decorations can be seen. The wax is second easily marketable product, used for making foundations and decorative candles. Bee venom and royal jelly was formerly used as an additive in homeland famous pharmaceutical products (Virapin, Vita-Apinol), but due to low prices of this raw materials on global market inland beekeepers are not motivated to produce them. Some amounts of frozen pollen for bumblebee rearing and propolis for disinfection’s and healthy products are requested from local buyers yearly.

## Agricultural policy and prospects for beekeeping

As mentioned above, years from 1990 to 2007 were the period of continuous decline of beekeepers and bee colonies, since 2008 stabilisation and slight increase is recorded. Tendency of higher concentrations of hives per apiary can be seen. Positive changes are linked with adoption of Slovak Beekeeping Programme co-financed for its half by EU. This programme following valid regulations of the European Communities, stipulating conditions for providing subsidies to implement measures to improve general rules for the production and marketing of honey for the three year periods has been very well adopted by every beekeeper. Beekeepers receive subsidies for technical assistance (f.e. organising courses, seminars, purchase of defined equipment), Varroa mite control, transhumance rationalisation (purchase of equipment for migration), honey analyses and bee colonies renewal (buying queens). Around 1,18 million € were used in 2017 from this programme to develop and stabilize beekeeping sector, budget utilisation was 100 %. Most of subsidies goes into two priorities, which are technical assistance (45 %) and combating varroosis (40 %). The previously adopted EC agricultural supporting schemes has been focused on greater beekeepers able to use them to build honey-processing plants and invest into their farms, but most of apiarists are not open to call for such grants because of time consuming administration or insufficient source for co-financing of such projects. There is also national flat-rate payment, which is cca 2 € per hive. We are quite optimistic and believe that Slovakia will remain a country of great beekeeping traditions and home for thousands of beekeepers. We hope that the new Beekeeping supporting programme, extended from 6 to 8 supported priorities for the 2017 - 2019 period, will help us to keep Slovakia buzzing.

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