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Turopolje Pig (Turopoljska svinja)

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Abstract

Turopolje pig is a fatty-type pig breed created during the Middle Ages in Turopolje region in Central Croatia. Due to its modest demands, resilience and good adaptation to outdoor rearing, the Turopolje pig has been an important food source for the local population for centuries. However, with the transition from extensive to intensive pig production in the middle of the twentieth century, this autochthonous pig breed almost disappeared. Currently, despite the state support, Turopolje pig is still endangered, with a population of only 116 sows and 14 boars. Hence, to preserve Turopolje pig breed in a more sustainable way, the breed needs to be more economically exploited and scientifically explored. Thus, the aim of this chapter is to present history and current status of Turopolje pig breed, its exterior phenotypic characteristics, geographical location, production system and main products. Moreover, a collection and review of available literature data (available until August 2017) on reproductive and productive traits, including growth performance, carcass traits and meat and fat qualities of Turopolje pig breed, were carried out. Although studies on Turopolje pig are scarce, the present review gives the first comprehensive insight into this still untapped local breed of pigs investigated in the project TREASURE.

Keywords: traditional European breed, TREASURE, productive traits, phenotype, Croatia

1. History and current status of the breed (census)

Turopolje pig is a native Croatian breed, created during the early Middle Ages in Turopolje region near Zagreb in Central Croatia. It is a medium-sized, primitive, fatty-type pig breed. As it developed over a long period of time, the breed perfectly adapts to its natural environment, primarily continental climate conditions and lowland forest ecosystems. Due to the modest demands, resistance and good adaptation to local marsh pastures and oak and beech forests, the Turopolje pig breed for centuries has been an important food source for the local population. However, the rapid penetration of imported lean pigs in the second half of the twentieth century, as well as the ban of forest grazing, significantly reduced the interest in this breed. The result was an emerging decrease of the population size, and since 1996, the Turopolje pig breed is under the state protection. Unfortunately, despite the support the Turopolje pig breed is still endangered, and the renewal of the population has been very slow. Census of Turopolje pig breed is presented in **Figure 1**. Presently, there

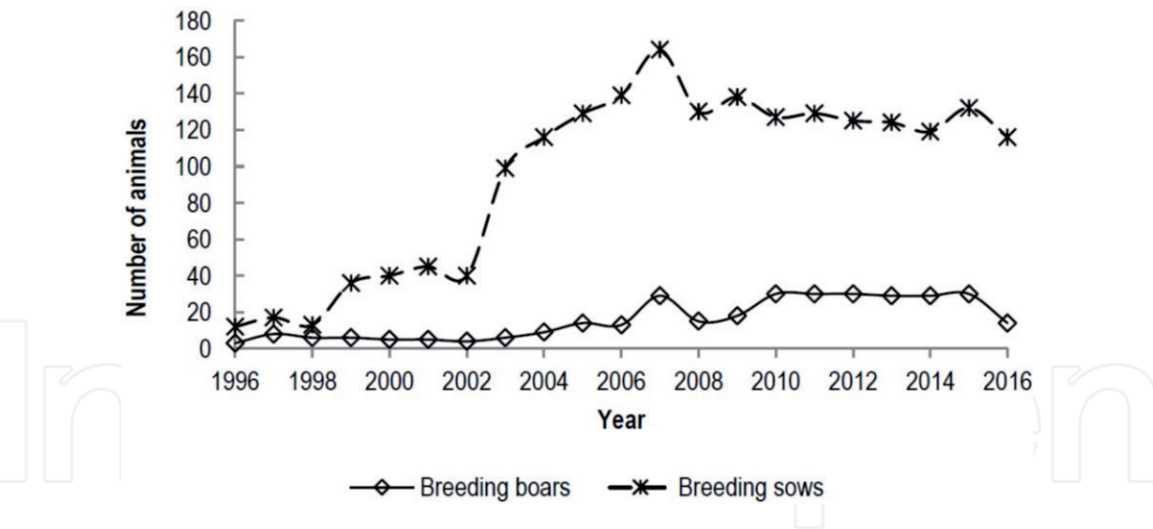


Figure 1.
Census of Turopolje pig breed, presenting number of sows and boars per year, starting with the year of heard book establishment.

are only 12 registered farms of Turopolje pigs with about 116 breeding sows and 14 boars in the latest available status (August 2016 [1]). In the past, the meat of Turopolje pig was considered better than meat of other pig breeds [2], but today its use is sporadic and almost completely replaced with the meat of modern pig breeds and hybrids. However, as a part of the current trends in the protection of local breeds and their sustainable farming systems, it becomes justified to review the breeding of Turopolje pig breed for production of meat and local meat products. Renovation of traditional link between breed and its products and their technological and marketing development may, by itself, represent the best way for recovery and long-term preservation of Turopolje pig breed on economically sustainable base.

2. Exterior phenotypic characteristics

The Turopolje pig breed morphology information is summarized in **Table 1**. It is a medium-size breed with distinctive sporadic black spots on a white or gray coat, mostly curly hair and drooping, half-folded ears (**Figures 2 and 3**). Head is medium long with slightly concave profile and sturdy snout, which ensures a good

Measurement (average)	Adult male	Adult female
Body weight (kg)	106.0	96.6
Body length ¹ (cm)	70.0	72.7
Head length (cm)	28.0	27.0
Tail length (cm)	30.0	29.9
Ear length	22.0	22.5
Chest girth (cm)	116.0	111.2
Height at withers (cm)	67.0	65.2

¹Measured from the tip of the nose to the starting point of the tail.

Table 1.
Summary of morphology information on Turopolje pig breed.



Figure 2.
Turopolje sow with piglets.



Figure 3.
Turopolje boar.

rooting ability. Body constitution is firm, but not muscular. Legs are high, with solid joints. Frame is short and not too deep. Back is medium in width and slightly lowered at croup; shoulders and hams are less developed. Breed is lively tempered and curious.

3. Geographical distribution and production system

Turopolje refers to a plain extending over a 45-km-long and 23-km-wide alluvial plateau, occupying an area of about 600 km², with an average altitude of 110 m above sea level. It is located between Posavina (wetland plains along the Sava River) in the north and the Vukomeričke gorice (low altitude hills) in the south. The Odra River flows through it with the Lomnica tributary. Characterized by lowland oak forests, periodically flooded pastures and continental climate, Turopolje has always been suitable for outdoor livestock production, especially pig breeding. In the past Turopolje pig breed spread from Turopolje to Sisak and Draganić, later to the parts of Slavonija and Podravina and all the way to the south-western parts of Hungary. However, with the transition from extensive to intensive pig production in the mid of twentieth century, its farming drastically reduced and the breed almost disappeared. Today, Turopolje pig is reared only in a few localities, mainly in Turopolje forest and Nature Park Lonjsko Polje (**Figure 4**), where traditional way of pig farming has been maintained. Basically, it comprises a low-input technology of animal housing and feeding in a fully outdoor system on pasture at local forests and marsh meadows. Pigs are provided with only a simple shelter, water and some supplemented feed (e.g., 0.5–2 kg

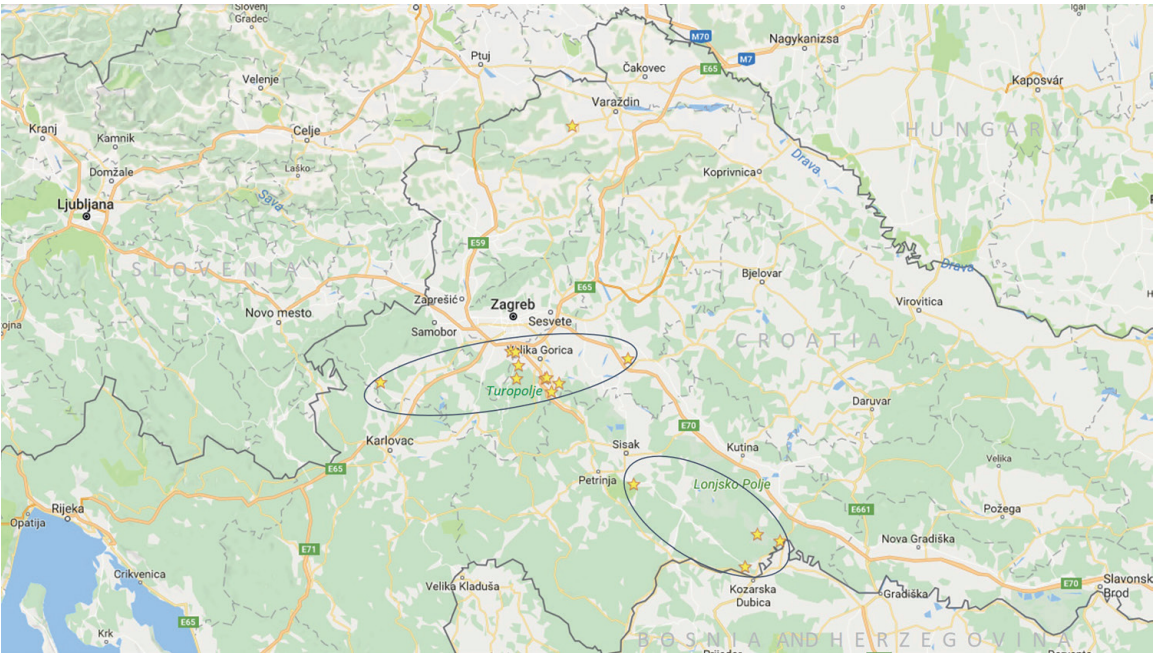


Figure 4.
Geographical distribution of Turopolje pig farms.

of corn per animal daily), while the majority of animal’s diet is supplied from natural resources (e.g., acorn, grass, worms, snails, shellfish, etc.). Finishing at high-grain diet, prior to slaughter is usual. Indoor housing and intensive production systems are rarely practiced.

4. Organizations for breeding, monitoring and conservation

The Association “Plemenita Općina Turopoljska” (*Universitatis nobilium Campi Turopolya*) is the responsible breeding organization for Turopolje pig breed, assisted by Croatian Agricultural Agency, which monitors the population and keeps herd books (**Table 2**). Conservation of Turopolje pig breed started once Croatia signed Convention on Biological Diversity (CBD) in 1997, and breed was added to the FAO list of endangered breeds in category of regional breeds [3]. After CBD ratification a national biodiversity strategy was established, including an action plan for the conservation of endangered breeds. Since then Turopolje pig breed is under the state of renewal and *in situ* protection. Funds for conservation are provided by the state.

Name of organization	Address	Web address
Plemenita Općina Turopoljska (POT)	Zagrebačka 37, 10,410 Velika Gorica, Croatia	http://turopolje.hr/
Croatian Agricultural Agency (Annual reports 2008–2015)	Ilica 101, 10,000 Zagreb, Croatia	http://www.hpa.hr/sektori/ sektor-za-razvoj-stocarske- proizvodnje/odjel-za-svinjogojstvo/ izvorne-pasmine/

Table 2.
Contact details of breeding organization for Turopolje pig breed.

5. Productive performance

5.1 Reproductive traits

Basic data obtained on reproductive traits in this review are presented in **Table 3**. The age of sows at first parturition is approximately 23 months [8, 9]. Sows of Turopolje pig breed have 0.5–2.5 litters per year [1, 4, 6, 8] with 4.5–6.7 piglets [1, 5–9] of 1.2 kg live body weight [5, 8]. The percentage of stillborn piglets and piglet mortality rate until weaning is relatively high in the considered studies (5.2–22.1 [1, 5–7] and 7.4–26.5% [1, 6], respectively). Duration of lactation is prolonged in comparison to modern intensive systems to 42 days [5, 7], which leads to a longer farrowing interval (312 days on average [1, 4, 6, 8]), but not to a higher weaning weight (4.2 kg [7]).

5.2 Growth performance

Basic data on growth performance obtained in this review are presented in **Tables 4** and **5**. In Turopolje pig breed, studies provided only growth rate in period of lactation and the overall growth rate for the whole fattening stage (defined as overall). It should also be noted that majority of collected studies simulated practical conditions of the production systems used and that only a smaller part of the studies actually aimed at evaluating the breed potential for growth. The average daily gain in Turopolje pigs during lactation is 101 g/day [7], which is less than expected in modern pig breeds. Also, an average value obtained for the overall fattening stage is characterized by a considerably slower growth rate (429 g/day [10–12]) than modern pig breeds. In the context of the evaluation of growth performance, it is also of interest to observe the extreme values, because it can be assumed that the maximum figures exhibit the growth potentials of Turopolje pigs in ad libitum conditions of feeding (\approx 556 g/day in the overall fattening stage [12]).

In considered studies, the information on feed intake and feed nutritional value were scarce, which limits the evaluation of growth potential. Average daily feed intake reported was around 2.0 kg/day in the overall fattening period [11, 12].

Reference	Sow age at first parturition (mth)	Litters per sow per year	No. of piglets alive per litter	Piglet live weight (kg)	Stillborn per litter (%)	Mortality at weaning (%)	Piglet weaning weight (kg)	Duration of lactation (d)	Farrowing interval (d)
[1]	–	1.1	4.7	–	10.7	26.2	–	–	335
[4]	–	2.5	–	–	–	–	–	–	146
[5]	–	–	6.3	1.3	18.2	–	–	42	–
[6]	–	1.2	4.2	–	5.2	7.4	–	–	307
[7]	–	–	6.7	–	22.1	–	4.2	42	–
[8]	23.5	0.8	5.3	1.2	–	–	–	–	462
[9]	22.1	–	4.5	–	–	–	–	–	–

No. = number, mth = month, d = days.

Table 3.
Summary of collected literature data on reproduction traits in Turopolje pig breed.

Reference	Feeding	No. of animals	ADG lactation ¹	ADG fattening ²
[7]	–	60	101	–
[10]	–	20	–	556
[11]	Ad Lib	15	–	340
[12]	Ad Lib	12	–	392

No. = number; ADG = average daily gain in g, Ad Lib = ad libitum feeding regime.

¹ADG in a period of lactation regardless of how long it was.

²ADG in a period of fattening is reported as the overall growth rate for the whole studied period (from approximately 30 kg body weight until slaughter).

Table 4.
Summary of collected literature data on growth performance in Turopolje pig breed.

Reference	Feeding	ME content of feed (MJ/kg)	CP content of feed (%)	No. of animals	ADFI fattening ¹
[10]	–	–	–	20	2.30
[11]	Ad Lib	13.4	17.6	15	1.23
[12]	Ad Lib	12.9	15.5	12	2.51

No. = number; ADFI = average daily feed intake in kg/day, Ad Lib = ad libitum feeding regime, ME = metabolizable energy, CP = crude protein.

¹ADFI in a period of fattening is reported as the overall growth rate for the whole studied period (from approximately 30 kg body weight until slaughter).

Table 5.
Summary of collected literature data on average daily feed intake (in kg/day) in Turopolje pig breed.

5.3 Body composition and carcass traits

Basic data obtained in this review with some of the most commonly encountered carcass traits that could be compared are presented in **Table 6**. In considered studies, pigs of Turopolje breed were slaughtered at approximately 437 days of age (140–679 days [5, 10–13]) and average 96 kg live weight [5, 10, 12, 13]. Dressing yield was around 80% [5, 10, 12, 13] and lean meat content around 40.0% (SEUROP

Reference	No. of animals	Final age (d)	Final BW (kg)	Hot CW (kg)	Dressing yield (%)	Lean meat content (%)	Backfat thickness (mm)			M ¹ (mm)	Loin eye area (cm ²)
							S ²	At withers	At last rib		
[5]	10	679	100	80	79.9	40.6	–	–	32	–	–
[10]	20	253	102	82	80.3	–	–	61	39	–	–
[11]	8	140	–	58	–	43.6	29	–	–	47	22
	7	175	–	70	–	41.4	32	–	–	46	25
[12]	20	552	95	75	79.1	35.8	41	54	40	51	–
[13]	10	584	82	66	80.1	38.2	–	–	–	–	–
	9	679	100	80	79.8	40.5	–	–	–	–	–

No. = number; BW = body weight, CW = carcass weight.

¹M muscle thickness measured according to ZP method [at the cranial edge of gluteus medius muscle (mm)].

²S backfat thickness measured according to ZP method [above gluteus medius muscle (mm)].

Table 6.
Summary of collected literature data on body composition and carcass traits in Turopolje pig breed.

Reference	No. of animals	pH 45	pH 24	CIE ¹			IMF (%)	IMF fatty acid composition (%)				BF fatty acid composition (%)			
				L*	a*	b*		SFA	MUFA	PUFA	n6/n3	SFA	MUFA	PUFA	n6/n3
[5]	10	–	–	–	–	–	3.0	39.6	54.8	5.6	–	37.0	50.8	12.2	–
[11]	8	6.10	5.47	–	–	–	–	–	–	–	–	–	–	–	–
	7	5.99	5.59	–	–	–	2.2	–	–	–	–	–	–	–	–
[12]	20	6.44	5.84	44.6	19.3	5.7	2.9	37.2	47.4	15.4	13.7	39.3	46.8	13.9	12.8
[13]	10	–	–	–	–	–	5.3	–	–	–	–	–	–	–	–
	9	–	–	–	–	–	5.8	–	–	–	–	–	–	–	–
[14]	10	–	–	–	–	–	3.0	–	–	–	–	–	–	–	–

No. = number, pH 45 = pH measured approximately 45 min post-mortem, pH 24 = pH measured approximately 24 h post-mortem, IMF = intramuscular fat, BF = back fat tissue, SFA = saturated fatty acids, MUFA = monounsaturated fatty acids, PUFA = polyunsaturated fatty acids.
¹CIE = objective color defined by the Commission Internationale de l'Eclairage; L* greater value indicates a lighter color, a* greater value indicates a redder color and b* greater value indicates a more yellow color.

Table 7.
Summary of collected literature data on meat quality in Turopolje pig breed.

classification or dissection [5, 10–13]). The backfat thickness values were measured at the position of withers averaged 57 mm [10, 12], at the level of the last rib 37 mm [5, 10, 12] and at the level of gluteus medius muscle 34 mm [11, 12]. Muscularity was measured as loin eye area averaged 23 cm² [11] and as muscle thickness above gluteus medius 48 mm [11, 12].

5.4 Meat quality

Basic data obtained in this review with some of the most commonly encountered meat and fat quality traits measured in longissimus muscle that could be found are presented in **Table 7**. In the studies reporting meat quality of Turopolje pigs, pH measured in longissimus muscle at 45 min and 24 h *post-mortem* were around 6.1 and 5.68, respectively [11, 12]. The intramuscular fat content ranged from 2.2 to 5.8 (3.7% in average [5, 11–13], and color measured in CIE L*, a* and b* color space was 44.6, 19.3 and 5.7 for L, a* and b* [12]. SFA, MUFA and PUFA content of intramuscular fat in longissimus muscle in the considered studies were around 38, 51 and 11%, whereas SFA, MUFA and PUFA content of back fat tissue were approximately 38, 49 and 13%, respectively [5, 12].

6. Use of breed and main products

Resilient and capable of foraging, Turopolje pig breed has always been able to survive in free range, which makes it particularly suitable for low-input, extensive production systems. Its use today represents a potential alternative to intensive farming, and it should be intended primarily for production of pork meat and products of premium quality. Meat is darker and redder in color than in standard pork, with fine muscular texture, which seems to be characteristic for this breed [4, 9]. There is a higher level of accumulation of fat tissue, especially in the subcutaneous area, and between the muscles. Meat of Turopolje pigs in today's gastronomy is mainly used in special occasions for the preparation of various local food specialties (e.g., “turopoljska kotlovina”, goulash, various pork roasts—**Figure 5**). It is also suitable for processing in typical meat products (e.g., dry-cured ham—**Figure 6**, bacon, dry-fermented sausages, etc.), which are highly appreciated by local consumers but for now rarely available in the market. In 2017, the breeding association “Plemenita Općina Turopoljska” applied for the registration of fresh meat from Turopolje pig with the protected designation of origin (PDO) label, and the procedure is underway at national level.



Figure 5.
Turopolje pig roast at local food fair.

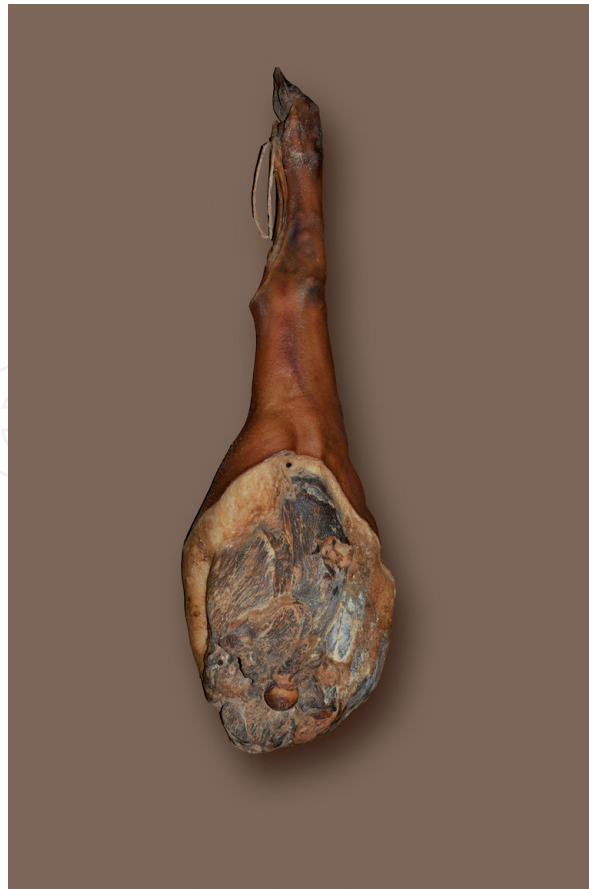


Figure 6.
Turopolje ham (photo by Blaž Šegula).

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