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Chapter

Mangalitsa (Swallow-Belly Mangalitsa) Pig

Čedomir Radović, Radomir Savić, Milica Petrović, Marija Gogić, Miloš Lukić, Dragan Radojković and Nina Batorek-Lukač

Abstract

Autochthonous pig breed is adapted to the specific local environment, fed with various locally available feedstuffs and well adapted to extensive conditions of housing. Their genes represent safety in the production of food in future times, in which the greater importance will be attributed to the resistance and adaptability of the breed. In terms of scientific substantiation, their performances and products are, as in the case of Mangalitsa pig, practically untapped. Thus, the aim of the present chapter is to present history and current status of Mangalitsa pig breed, its exterior phenotypic characteristics, geographical distribution, production management and main products from this Serbian autochthonous breed of pigs, one of the local pig breeds investigated in the project TREASURE. Moreover, a collection and review of available literature data, available until August 2017, on reproductive and productive traits of Mangalitsa pig breed were carried out. Mangalitsa is a late and extremely fatty pig breed with low fertility, long suckling period and a very weak-slow growth. Although studies on Mangalitsa pig are scarce, the current review gives the first insight into this local pig breed.

Keywords: autochthonous breeds, traditional European breed, TREASURE, productive traits, phenotype, Serbia

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

Mangalitsa is an autochthonous fatty type pig breed, created from the old Serbian Šumadinka breed. During the nineteenth century, pigs were the main export product of Serbia, especially in the northern part of the country (today's Autonomous Province of Vojvodina) and in the region of Šumadija (central part of Serbia). In Šumadija, pigs were mostly fattened in the forests where they were searching for oak and beech acorn and other forest feed resources. The majority of animals were exported to the former Austro-Hungarian monarchy. In that time, the pig farming was based on local indigenous breeds with the dominant breeds Šiška and Šumadinka. Šiška and Šumadinka were the most primitive breed of pigs, created by domestication of wild pigs *Sus scrofa ferus* [1]. Šiška once had high importance, in the relatively recent past (eighteenth century), not only in Serbia but also in Croatia, Slovenia, Hungary, Romania and Bulgaria. In the nineteenth century, a new breed Šumadinka was created by domestication of wild pigs (*Sus scrofa ferus*) and reared in slightly

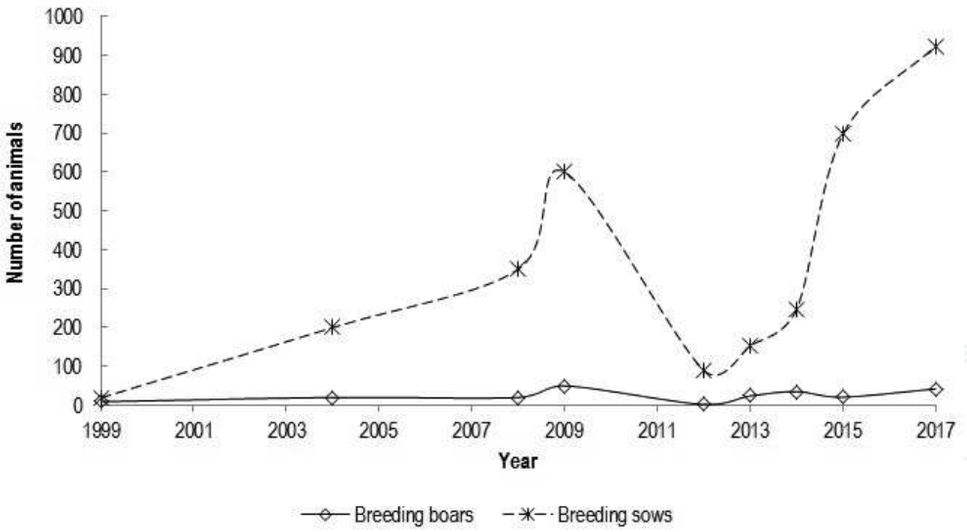

Figure 1.
Chronological population dynamics of Mangalitsa pig breed, presenting the number of sows and boars per year, starting with the year of herd book establishment.

better conditions. Both of these breeds are lost in their original form. However, Šumadinka can be considered as an important ancestor of Mangalitsa. In the Republic of Serbia, there are three Mangalitsa breed types: **swallow-belly strain** (Srem black Mangalitsa or Bođanovci pig developed in the area of Srem near Ruma, a village of Bođanovci [2]), **white strain** (blonde or Hungarian strain, created when in 1833 Prince Miloš Obrenović gave two boars and 10 sows of Šumadinka breed to the Hungarian nobleman Palatine Joseph on the farm Kisjeno where better rearing conditions, accommodation and food source were provided, which lead to the creation of more productive pig breed of white Mangalitsa) and **red strain** (mainly represented on the territory of Hungary and Romania and, in our country, present only in traces).

Apart from Serbia, the Mangalitsa is present in Austria, the Czech Republic, Germany, Romania, Hungary, Slovakia and Switzerland. Chronological population dynamics of Mangalitsa pig breed is presented in **Figure 1**. In 2016, only on the territory of Central Serbia, 321 sows and 32 boars were registered (in the records of the Main Breeding Organization). At the end of 2017, on the territory of R. Serbia, there were about 67 registered farms with 925 sows, 605 gilts and 42 boars registered in the records of the Main Breeding Organization, of which more than 95% are **swallow-belly strain**.

2. Exterior characteristics

The main morphological characteristics of the Mangalitsa breed are summarized in **Table 1**. It is a medium-size breed, known for its thick, wooly coat similar to that of a sheep. The three Mangalica breed types are blonde, swallow-belly and red Mangalitsa. **Swallow-belly strain** (**Figures 2** and **3**), which is one of the most numerous in Serbia, is late maturing type, resistant and well adapted to extensive rearing and housing conditions. It requires only a simple shelter from rain and snow. The head is relatively small, with large ears that hang in front over the eyes and face. The earlobe is set high and elastic to the touch. The ear length is 2/3 of the length of the head. The chest and short torso/body are broad and deep and extend to

just below the elbow. The back and loin are straight or slightly curved from the side view. The back part of the body and thighs are well developed, wide and muscular. The abdomen is long and cylindrical with the mammary complex consisting of four to six pairs of teats [1]. Limbs are long, wide and muscular. The skin is pigmented, dark or brown in colour, with dense, bright and curly bristles that are shorter in swallow-belly strain. The colour of bristles can be from grey-yellow to reddish (ginger). The eyelids, eyebrows, muzzle, nipples of the mammary complexes, hooves, tail tip and natural openings on the body are always black. Brinzej [3] states that there are two varieties of this type, of which one from the western breeding region is called "Buđanovac" variety named after the village Buđanovci. This variety has a greater part of the body pigmented (entire head, body and the sides of the body and the legs from the outer-lateral side to the claws). The second variety—"Otok" and "Lasa" named after the village of Otok in the western part of the Srem region—with the legs pigmented only to the hock joint and the lower part of the papilla is white. The Otok variety has regularly strongly developed bristles, which the "Buđanovac" variety lacks or is less developed. At birth, piglets have characteristic stripes, which disappear in 10 days in white strain piglets and in 3–4 months in swallow-belly strain.

Measurement (average)	Adult male	Adult female
Body weight (kg)	78	73
Body length[1] (cm)*	95	92
Head length (cm)	32	33
Chest girth (cm)	140	150
Height at withers (cm)	78	78
Number of teats	—	8–12

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

Table 1.
Summary of the main morphological characteristics of the Mangalitsa breed.

Figure 2.
Mangalitsa sow with piglets.

Figure 3.
Mangalitsa boar.

3. Geographical location and production system

Mangalitsa pigs are reared in the wider area of the Republic of Serbia, mostly along major waterways. Farms are located in the municipalities of Subotica, Sremska Mitrovica, Bačka Palanka, Vršac, Pančevo, Ub, Obrenovac, Ljig, Valjevo, Novi Sad, Kuzmin, Šid, Surčin and Kovilj (Krčedinska ada). Some Mangalica pigs can also be found on Stara Planina mountain (Municipality of Dimitrovgrad) and around Čačak and Kraljevo.

These pigs are usually reared in free-range conditions, outdoor, extensive or in semi-intensive production systems. Rearing of pigs implies a free holding in limited areas in pastures, woods or orchards. In extensive system, pigs are kept around the household, which depends on the number of animals and size of the owner's property, and in the winter period, animals are housed in cheap, wooden pig stables. Feeding them is primarily based on pasture and forest products (oaks, wild fruits). Additional daily meal represents an extremely small amount of grains per head, primarily corn. In extensive system sows very frequently farrow in the forest, which significantly complicates the control of productivity and recording. In semi-intensive conditions, sows are farrowed in objects, which allows for better control. In the growing and fattening phase, pigs are mostly outdoor.

4. Organizations for breeding, monitoring and conservation

Organization for breeding is regulated by the Law on Livestock [4]. The Institute of Animal Husbandry and University of Novi Sad, Faculty of Agriculture, are the authorized main breeding organization for selection and animal recording of breeding livestock in Serbia.

Information on population status in the last 20 years is collected by the organizations shown in **Table 2**. The law of incentives in agriculture and rural development defines the maximum amounts of incentives per head for breeding gilts, boars and sows of Mangalitsa, Moravka and Resavka [5]. Protection includes in situ *and* ex situ preservation. The number of breeders of indigenous breeds of pigs is increasing in the last year. Ex situ preservation is regulated by the rule book on incentives for the conservation of animal genetic resources in the gene bank [6].

Name of organization	Address	Web address
Institute for Animal Husbandry	Autoput 16, 11080 Zemun-Belgrade	http://istocar.bg.ac.rs/en/
University of Novi Sad, Faculty of Agriculture	Trg Dositeja Obradovića 8, 21,000 Novi Sad	https://www.uns.ac.rs/index.php/en/faculties/ffaculties/faculty-agriculture
Ministry of Agriculture, Forestry and Water Management	Nemanjina 22–26, 11000 Belgrade	http://www.minpolj.gov.rs/?lang=lat

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

5. Productive performance

5.1 Reproductive traits

The basic data obtained on reproductive traits in this review are presented in **Table 3**. The age of Mangalitsa pig breed sows at the first parturition is approximately 17.3 months [8, 12, 17, 18]. They have 1.2–2.0 litters per year [8, 10–13, 17] with around five piglets [7, 8, 12, 16, 18] of 1.1–1.6 kg live body weight [9, 12, 14, 16, 17]. Stillborn percentage of piglets ranges from only 2.2 to 7.5% [7, 8, 16], whereas piglet mortality rate until weaning in the considered studies varies from 2.0 to 11.1% [7, 8, 10, 12, 16]. Duration of lactation is prolonged in comparison to modern intensive systems to 50 days on average (ranging from 37 to 60 days [7–9, 11, 14–16, 18]), which leads to a longer farrowing interval (around 216 days on average [8, 10–13]) and higher weaning weight (from 8.1 to 15.1 kg [9, 13–16]).

5.2 Growth performance

The basic data on growth performance obtained in this review are presented in **Tables 4** and **5**. Due to big differences between studies with regard to the live weight range covered, we defined the stages for growth performance as lactation (regardless of how long it was), growing stage (from weaning to approximately 30 kg live body weight) and early, middle and late fattening stages estimated between approximately 30 and 60 kg, 60 and 100 kg and above 100 kg live body weight, respectively. Sometimes the source provided only the overall growth rate for the whole fattening stage (defined as overall) or even from birth to slaughter (defined as birth–slaughter, which is often calculated from the data given on live weight and age of pigs). It should also be noted that a big part of the 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. In the considered studies, the daily gain in the early growing stage that corresponds to lactation period was approximately 136 g/day [9, 12, 14–16]. The average daily gain in growing stage was 310 g/day [16]; 430, 519 and 405 g/day in early, middle and late fattening stage [12]; 434 g/day in overall fattening stage [12, 15, 16, 18, 20–22]; and 307 g/day [15, 16, 21] from birth to slaughter. 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 Mangalitsa pigs in ad libitum conditions of feeding (≈830 g/day in overall fattening stage [20]).

Reference	Sow age at the first parturition (mth)	Litters per sow per year	No. of piglets alive per litter	Piglet live weight (kg)	Still born per litter (%)	Mortality at weaning (%)	Piglet weaning weight (kg)	Duration of lactation (d)	Farrowing interval (d)
[7]	—	—	4.9	—	7.5	2.0	—	50.0	—
[8]	17.0	1.2	4.7	—	4.6	5.3	—	47.1	302
[9]	—	—	—	1.1	—	—	8.1	56.0	—
[10]	—	1.8	—	—	—	11.1	—	—	202
[11]	—	1.8	—	—	—	—	—	52.6	206
[12]	16.7	1.8	4.6	1.1	—	11.1	—	—	206
[13]	—	1.7	—	—	—	—	10.0	—	215
	—	1.8	—	—	—	—	10.2	—	203
	—	1.7	—	—	—	—	15.1	—	215
	—	2.0	—	—	—	—	—	—	183
[14]	—	—	—	1.2	—	—	9.7	60.0	—
[15]	—	—	—	—	—	—	7.5	50.0	—
[16]	—	—	6.8	1.6	2.2	10.9	7.1	37.0	—
[17]	16.9	1.2	—	1.3	—	—	—	—	—
[18]	18.5	—	4.6	—	—	—	—	50.0	—

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

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

Reference	Feeding	No. of animals	ADG lactation[1]	ADG growing[2]	ADG fattening[3]				ADG birth to slaughter
					Early	Middle	Late	Overall	
[9]	—	31	119	—	—	—	—	—	—
	—	31	125	—	—	—	—	—	—
[12]	—	35	—	—	430	—	—	430	—
	Ad lib	35	—	—	—	519	405	468	—
[14]	—	148	140	—	—	—	—	—	—
[15]	Rest	15	130	—	—	—	—	257	242
[16]	Rest	53	120	266	—	—	—	333	297
	Ad lib	71	180	353	—	—	—	422	375
[18]	Ad lib	12	—	—	—	—	—	480	—
[19]	—	—	—	—	—	—	—	—	—
[20]	—	32	—	—	—	—	—	830	—
[21]	—	16	—	—	—	—	—	414	315
[22]	Rest	12	—	—	—	—	—	268	—

No. = number, ADG = average daily gain in g, Ad lib = ad libitum feeding regime, Rest = restrictive feeding regime.
[1]ADG in a period of lactation regardless of how long it was.
[2]ADG in a growing period estimated from weaning to approximately 30 kg live body weight.
[3]ADG in a period of fattening is reported for early, middle and late fattening stages estimated between approximately 30 and 60 kg, 60 and 100 kg and above 100 kg live body weight, respectively. Sometimes the source provided only the overall growth rate for the whole studied period (in that case defined as overall).

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

Reference	Feeding	ME content of feed (MJ/kg)	CP content of feed (%)	No. of animals	ADFI fattening[1]			
					Early	Middle	Late	Overall
[12]	—	12	15	35	1.95	—	—	—
	Ad lib	13	13	35	—	2.85	3.19	2.54

No. = number, ADFI = average daily feed intake in kg/day, Ad lib = ad libitum feeding regime, ME = metabolisable energy, CP = crude protein.
[1]ADFI in a period of fattening is reported for early, middle and late fattening stages estimated between approximately 30 and 60 kg, 60 and 100 kg and above 100 kg live body weight, respectively. Sometimes the source provided only the overall daily feed intake for the whole studied period (in that case defined as overall).

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

In the considered studies, the information on feed intake and feed nutritional value were given only in one study [12], which limits the evaluation of growth potential. The average daily feed intake increased from 2.0 kg/day in the early fattening stage to 3.2 kg/day in the late fattening stage.

5.3 Body composition and carcass traits

The 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 the considered studies, pigs of the Mangalitsa breed were slaughtered at approximately

114 kg live weight [12, 15, 20–28]. Dressing yield ranged from 73 to 80% [12, 24–28] and lean meat content 28 to 37% (SEUROP classification or dissection [19, 22–25]). The backfat thickness values measured at the level of the last rib span from 42 to 81 mm [12, 20–25], at the position of withers from 59 to 102 mm [12, 20–24] and at the level of *gluteus medius* muscle from 48 to 79 mm (n = 8). Muscularity measured as loin eye area was 24 cm^2 [22, 23] and as muscle thickness measured from the vertebral canal to the cranial edge of *gluteus medius* muscle around 60 mm [12, 22].

5.4 Meat quality

The 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 Mangalitsa pigs, pH measured in *longissimus* muscle at 45 minutes and 24 hours *post-mortem* was around 6.1 [12, 22, 25–27, 29] and 5.6 [12, 15, 22, 26, 27, 29, 30], respectively. The intramuscular fat content is very high in reported studies and ranges from 2.9 to 18.2% [15, 19, 21, 24–31]. The colour measured in CIE L, a, b colour space was approximately 45, 11.4 and 4.2 for L, a* and b* [12, 15, 22, 30], indicating relatively dark colour of Mangalitsa. In the considered studies, SFA, MUFA and PUFA contents of intramuscular fat in the *longissimus* muscle were in around 35, 56 and 7%, respectively, with high n6 to n3 ratio (9.2–37.3 [21, 22, 26, 27, 32]).

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		
[12]	35	—	116	—	78.3	—	55	72	54	58	—
[15]	15	604	147	—	—	—	53	—	—	—	—
[19]	—	—	—	80	—	28.8	—	—	—	—	—
[20]	32	—	158	—	—	—	79	102	81	—	—
[22]	12	—	133	—	—	33.0	48	68	51	62	24
[23]	13	—	125	—	—	32.3	60	72	52	—	24
[24]	10	—	101	74	73.0	27.8	52	62	44	—	—
[25]	13	—	104	82	79.3	34.5	—	64	44	—	—
	10	—	104	82	79.3	37.1	—	59	42	—	—
[26]	12	—	102	80	77.4	—	55	—	—	—	—
	10	—	98	77	73.9	—	52	—	—	—	—
[27]	24	—	101	77	77.7	—	—	—	—	—	—
[28]	16	—	76	61	80.1	—	—	—	—	—	—

No. = number, BW = body weight; CW = carcass weight.
[1]M muscle thickness measured according to ZP method (at the cranial edge of gluteus medius muscle (mm)).
[2]S 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 Mangalitsa pig breed.

Reference	No. of animals	pH 45	pH 24	CIE[1]			IMF content (%)	Fatty acid composition[2] (%)			
				L*	a*	b*		SFA	MUFA	PUFA	n-6/n-3
[12]	35	5.95	5.77	56	10.3	5.1	—	—	—	—	—
[15]	15	—	5.46	46	12.8	5.2	8.4	—	—	—	—
[19]	—	—	—	—	—	—	8.1	—	—	—	—
[21]	16	—	—	—	—	—	5.1	39.5	56.4	4.1	—
[22]	12	6.11	5.50	40	11.8	3.7	—	33.3	50.3	11.6	17.9
[24]	10	—	—	—	—	—	13.2	—	—	—	—
[25]	—	6.04	—	—	—	—	8.1	—	—	—	—
	—	6.32	—	—	—	—	5.5	—	—	—	—
[26]	12	6.12	5.80	—	—	—	18.2	33.9	57.2	5.9	37.3
	10	5.89	5.41	—	—	—	12.1	35.5	55.5	6.5	9.2
[27]	24	6.01	5.68	—	—	—	15.2	34.6	56.6	6.1	14.1
[28]	16	—	—	—	—	—	9.8	—	—	—	—
[29]	—	6.42	5.56	—	—	—	2.9	—	—	—	—
[30]	7	—	5.47	38	10.9	2.9	6.4	—	—	—	—
[31]	—	—	—	—	—	—	8.0	—	—	—	—
[32]	22	—	—	—	—	—	—	35.6	56.6	6.9	25.1

No. = number, pH 45 = pH measured approximately 45 minutes post-mortem*, pH 24 = pH measured approximately 24 hours* post-mortem*, IMF = intramuscular fat, SFA = saturated fatty acids, MUFA = monounsaturated fatty acids, PUFA = polyunsaturated fatty acids.*
[1]CIE = objective colour defined by the Commission Internationale de l'Eclairage; L greater value indicates a lighter colour; a* greater value indicates a redder colour; b* greater value indicates a more yellow colour.*
[2]For fatty acid composition, only pigs on control diet were considered. Control diets differed among studies, to see diet composition address to the corresponding source.

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

6. Use of breed and main products

Mangalitsa is a late maturing pig breed, selected for fat production. It has low fertility, long suckling period and a very weak-slow growth. But on the other hand, Mangalitsa is very resistant and well adapted to extensive conditions of housing, where the needs are only for a simple shelter from rain and snow. With such features, its cost-effectiveness is in low investment in housing facilities with large areas for pasturing and acorn nutrition, preferably if an organic breeding system is possible. Considering the low production performance (low daily gain and meatiness), crossbreeding with the Moravka, Resavka, Duroc, Hampshire or Berkshire breed could contribute to an improvement of growth and carcass traits, with the shorter fattening period and higher percentage of meat content in the carcass. The study of Radović et al. [22] showed not significantly better growth rate between Mangalitsa and Mangalitsa × Moravka crossbreeds (average daily gain, 267.9 vs. 336.9 g) and similarly not significant content of meat in carcass sides (33.2 vs. 33.9%). The animals not chosen for the nucleus herd could be crossed with Duroc, Hampshire or Berkshire which would contribute to more economical production of meat and the production of traditional high-value products (ham, sremski kulen

and Sremska sausages) and their marketing as highly valuable organic products or products protected by a geographical indication. Dry-fermented sausages are meat products with a very long tradition of production, and today there are numerous national variants of these products. The most popular types of traditional fermented sausages in Serbia are kulen [37] and Sremska sausage. Kulen, a traditional fermented dry sausage, is a well-known and very popular meat product in the north of Serbia (Srem, Bačka) and Croatia (Slavonia, Baranja). For all variants of basically the same product, high-quality meat from mature pigs with a relatively low water content, intensive red colour and firm consistency is used as raw material. The meat used is primarily from the leg, shoulder and possibly some parts of the neck; a small amount of firm backfat tissue is also used (muscle and adipose tissue; 75:25 [33]). Smoking and maturation of sausages were carried out in the winter period (December to February).

Sremska sausage is a Serbian dry-fermented sausage traditionally produced in the north-western part of Serbia (Srem region), where it was produced in village households. It was made of grounded (about 8 mm) pig meat and backfat and mixed with salt and spices. The mixture was filled into pig's small intestines, smoked and dried for 14–21 days depending on ambient conditions [34]. Sremska sausage is of pronounced red colour, tender texture and slightly hot taste, with a fermented meat odour and a mild note of spices and smoke [35, 36]. The meat and adipose tissue as well as meat products of Mangalitsa are much appreciated by the Serbian consumers; the scientific efforts were not only limited to preserve the breed as such but also to better exploit its potential for human consumption.

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