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Livestock production system and animal genetic resources preservation and utilisation

Gajic, Ž.
Faculty of Agriculture, Belgrade, Serbia and Montenegro

Bogosavljevic-Boškovic Snežana
Faculty of Agronomy, Cacak, Serbia and Montenegro

Pušić M.
Center of Science Application in Agriculture, Belgrade, Serbia and Montenegro

Mitrović S.
Faculty of Agriculture, Belgrade, Serbia and Montenegro

Abstract: Some of the significant changes taking place in the livestock production, particularly those in the animal genetic resources in Serbia of how to be used and preserved have been put forth in the paper. In addition to preserving the existing biodiversity, a good-tech use of the autochthonous genetic material of the cattle and poultry strains and breeds would be provided when producing intrinsically healthy diet and when paving the way for as economical production process and environmental protection as possible.

Keywords: livestock production systems, animal genetic resources, indigenously healthy diet, lipids, cholesterol.

Introduction

Livestock production has been intensified recently to the extent catching up with the industrial production level. Nevertheless, for improving rearing conditions and cattle product quality, then, for attaining healthy food quality and cutting down production process and environmental protection costs, a return to a

natural and to a sustainable livestock production has increasingly been advocated.

Serbia is rich in the well-preserved animal genetic resources, i.e. in cattle and poultry autochthonous breeds. Their highest value lies not only in their genes, as a source of traits such as the ability of their adaptation, but also in their vitality, resistance to diseases and in a good meat, milk and egg quality.

Sustainability of the animal genetic resources

Having preserved an unimpaired, healthy and comparatively uncontaminated environment, Serbia is rich in a huge growing potential of field crops, fodder in lowlands, hay in meadows and on large pastures in the highlands and in the well-preserved genetic resources, too.

Tab.1. The autochthonous breeds of the livestock and poultry in Serbia

Species	**Breeds and strains**
Cattle	Busha - Grey - Black - Dark - Red Metohian Podolian
Horses	Domestic highland breed Nonius
Pigs	Mangalitsa - White - Weasel - Suboticka Moravka Resavka
Sheep	Zackel - Sjenica - Svrljig - Pirot - Vitorog - Bardoka Tsigai - Coka - Sombor
Goats	Domestic Balkan Goat
Poultry	Domestic Chicken - Sombor Crested - Naked Neck - Svrljig Black Sombor Ruffled Goose

These resources refer to as the autochthonous cattle and poultry breeds and strains, which resulted from the specific environmental, economic, historical and other conditions that are still favouring animal growth. The changes in these conditions are inevitably causing breeds and strains to change, evolve, vanish or melt with one another's traits so becoming adapted to the new circumstances and needs. Two cattle (Busha and Podolian), two horse (Domestic mountain breed and Nonius), three pig (Mangalitsa, Moravka and Resavka), two sheep (Zackel and Tsigai), one goat (domestic Balkan), three hen (Sombor Crested, Naked Neck, and Svrljig Black) and one goose (Sombor Ruffled Goose) breeds have been reported so far. The highest value of these breeds lies in the genes they are containing, not only as a source of their ability of adaptation, but also of their stamina, resistance to diseases and of good meat, milk and egg quality.

All the cattle breeds and strains on the areas of Serbia have shown a high level of genetic variability which is of huge importance to rearing the existing and breeding the new genotypes (tab.1).

Livestock production systems

Farming in unprotected conditions or organic plant and cattle production or biofarming have increasingly become intriguing in the recent years with the aim of improving rearing conditions, cattle product quality and accomplishing a better natural and healthy food quality and of lowering production process and environmental protection costs, too.

The leading British specialist of pig rearing in the open E.J.Ouka introduced the system of "Biopigs" for producing pigs of the desired characteristics and rearing in agreement with health protection standards without antibiotics and growth stimulators in pig diet. This rearing mode functions in the following way: the area 4 ha by size is split up into two parts; the one for saws and boars consisting of eight fenced parts detached by an electric fence and the other intended for bringing forth pigs having five fenced parts. Each fenced part has an appropriate number of mountable buildings required for cattle housing. The system functions with five animals being transferred weekly, the first five pigs being weaned, the second five paired and the remaining five bringing forth pigs. Within such rearing system, the boars could move around, with ten of them introduced per one hundred saws. One week before pigs will be brought forth, saws have been transferred from a fenced space to the pig lying building awaited by five buildings, picking out themselves one of the buildings for bringing forth piglets. After 24 hours have elapsed from bringing forth piglets, the piglets will move away from mother and be housed and kept in the separate piglet rearing buildings until reaching body weight of up to 30kg. The saws are then dried up and paired anew. In such a way, reproducing process is completed. Produced piglets can be sold or further fattened in the temporarily assembled buildings till reaching body weight of up to 100 kg when they are sent to a slaughter house.

Several types of the buildings for housing single categories are available and are made of galvanized steel isolated with styrofoam.

The soil for these facilities is used for a year, after which, these facilities are moved to another soil, the previous one now being fertilised and used for

growing field crops. In two years' time, these facilities can be moved back to the same location. Apart from fields, this rearing pattern may be laid in orchards as well, but with utmost care taken of the trees. The system is also ideal to be established in the rural holdings.

Tab.2. The effect of rearing system on carcass traits and lipid content

Traits	**Rearing systems**		
	Indoor	**Outdor**	**P**
Wight at slaughter, kg	257.0	296.0	0.050
Hot carcass weigdt, kg	190.6	215.3	0.115
Fat depth, mm	18.7	26.3	0.061
Muscle depth, mm	113	130	0.083
Lipid content in backfat, %	73.6	74.4	0.787
Vitamin E, μg/g	34.1	46.3	0.132
Lipid content in MLD, %	1.69	1.60	0.744
Vitamin E, μg/g	1.93	1.35	0.235

As can be seen from the tab.2., the pigs reared outdoors achieved noticeably higher body weight (296kg) than they did with indoor rearing system 9257kg) (Lebret et al., 2002). In addition, the outdoor rearing system had no impact on the lipids contained in the fat tissue and in the long back muscle (in terms of Minimal Lethal Dose), but significantly contributed to an increase in the fat acid level, particularly of α- linoleic acid. An increasing trend of vitamin E in fat tissue (34,1 in indoor, i.e.46.3% in outdoor rearing system) suggested a limited oxidizing process in such tissue. Housing system remarkably influenced metabolism in the muscle tissue, which altogether contributed to a significantly improved meat quality, particularly of its nutritional value with heads reared outdoors.

Similar findings were evidenced with cattle researches. In fact, the researches have shown that such rearing system along with an appropriate diet may accomplish visible changes in the lactic fat content, i.e. in the delineation of fat acids. Thus, Dhiman et al., 1996, stated that milk of grazing cows had a higher portion of conjugated linoleic acid rather than being in those fed with commercial bulky feed. Likewise, Parodi, 1999, came to the result determining the concentration of conjugated linoleic acid to be twice to three times higher in summer than that concentrated in the winter months. The reason for this is that cows in Australia and New Zealand are mainly grazed on pastures rich in polyunsaturated fat acids. Further, Parodi, 1999, found cows to have the ability of translating the potential anti-cancerous matter from diet into milk.

Tab.3. Tissue ratio in primal carcass cuts
(Bogosavljevic-Boskovic Snezana et al., 1996)

Experiment	System of rearing	Tissues		
		Muscle	Bones	Skin
I	In	65,73	23,43	9,72
	Si	67,63	22,26	8,93
II	In	66,04	22,95	9,82
	Si	67,01	22,48	9,28

Tab.4. Lipid (L) and protein (P) content in carcass primal cuts

Experiment	System of rearing		Primal cuts		
			Breasts	Drumsticks	Thighs
I	In	L	2,64	8,18	5,21
		P	22,84	18,62	20,70
	Si	L	2,27	7,08	4,86
		P	23,55	19,21	21,75
II	In	L	2,22	8,56	5,25
		P	23,32	19,42	20,92
	Si	L	2,04	7,45	3,86
		P	23,65	19,50	21,92

Poultry production system also seems highly remarkable and an intriguing. Thus, such rearing system examined for fattening traits and poultry meat quality has shown that, after of week of their fattening, broilers reared in a semi-intensive mode had lower body weights, lower daily growth increment and slightly weaker diet conversion, but a lower mortality, too. However, as far as the meat share and its muscle tissue are concerned, the broilers grown in outlets were found to have achieved better results. Fat content in drumstick and thigh muscles of the broilers was lower, whereas proteins were somewhat higher, which benefits the fact of a better broiler meat quality when reared semi-intensively (Bogosavljevic-Boskovic Snezana, 1994, Bogosavljevic-Boskovic Snezana, 1996); Bogosavljevic-Boskovic Snezana, 1999, Bogosavljevic-Boskovic Snezana et al., 2003.

The use of animal genetic resources

Preserving and economical utilisation of the animal genetic resources is of paramount importance for furthering livestock production and lifting meat, milk and egg quality, too.

The intensive production of pork meat is facing with certain problems, essentially affecting embryo and post-embryo mortality, fertility and, particularly technological meat quality. Speaking about meat quality, an optimal level of dry matter, proteins and intramuscular fat is required. The share of intramuscular fat

of 2% enables the optimally soft and juicy pork meat. In addition, such a rearing mode also exerts other meat traits visibly felt by consumers when consumed (taste, smell and the like).

Lastly, technological indices on the meat quality and appropriate requirements being set for this purpose are primarily related to pH value and to the ability of binding water. How important meat ability to retain its own water or to optimally bind its extra added amount over the processing is needless to mention. The characteristics, we have been concerned above, have significantly been influenced by breed, rearing conditions, by how animals are treated and the like. As can be seen from the tab.5, Mangalitsa has attained the best results in terms of meat quality.

Tab.5. The indices on the meat quality (Gajic and Isakov, 2000)

Characteristics	**Subotica Mangalitsa**		**Domestic meaty Breed**		**Belgian Landrace**	
	x	**%**	**X**	**%**	**x**	**%**
Dry matter content	27,53	100,00	26,50	96,26	25,87	93,07
Protein content	23,87	100,00	24,00	100,5	23,17	97,07
Fat content	2,93	100,00	1,93	65,87	1,67	57,00
pH_1 of ham	6,43		6,46		6,12	
pH_{24} of ham	5,95		6,16		6,07	
pH_1 of MLD	6,42		6,43		6,19	
pH_{24} of MLD	5,96		6,13		6,11	
Water retaining capacity, cm^2	3,75		3,56		4,14	

Tab.6. The influence of genotype on the lipoprotein and fat acid content (Szabo, 2001)

Traits	**Unit measure**	**Pietrain**	**Mangalitsa**		
			Blond	**Weasel**	**Red**
Cholesterol in the blood	mmol/l	2,25	2,33	2,41	2,13
HDL- cholesterol	mmol/l	0,97	1,07	1,11	0,92
Triglyceride in the blood	mmol/l	0,34	0,40	0,44	0,33
Saturated fat acid in fat tissue	%	42,54	39,55	-	36,99
Unsaturated fat acid in fat tissue	%	57,16	60,45	-	63,01

The latest studies led in Hungary have shown that Red Mangalitsa Kornval and F1 crossings between Durok and Mangalitsa contained the most suitable either cholesterol or its useful HGL level in blood (Red Mangalitsa 2,13 and 0,92 mmol/l, respectively) compared with any one of the fourteen genotypes being surveyed. Further, saturated fat acids were found to amount to 39,53% in White Mangalitsa, and to 36,99% in Red Mangalitsa, being noticeably lower than in the remaining genotypes. The share of fat acids was the highest (60,45 and

63,01%, respectively) in these two pig breeds, with statistically significant differences found in relation to the remaining genotypes.

Therefore, the most favourable ratio between the saturated and unsaturated fat acids was established in Mangalitsa, while after introducing unsaturated fat acids the low density lipoprotein (LDL) content was, but the high density one (HDL) was not decreased.

Beef meat falls under foodstuffs of high nutritive value and with relatively high content of good quality proteins (lysines), vitamin B complex, iron, copper and zinc. Podolac breed, as an autochthonous one of threefold abilities may significantly impart meat industry. Namely, earlier studies of Poli et al., 1996 (cit. by Marsico et al., 2002) suggested cholesterol content being lower in the Podolac breed meat than in the remaining breeds being investigated. Additionally, the results of Marisco et al., 2002 (tab.7.) have shown the Podolac breed meat and of the one being the cross of Podolac and Limusine to contain a higher content of the polyunsaturated fat acids considered outstanding in terms of nutritiveness and healthiness.

Tab.7. The influence of genotypes on the fat acid content

Traits	Genotype		Significance
	Podolac Podolian	Limuzin x Podolac Limusine x Podolian	
Saturated acids, %	45,22	46,66	P<0,01
Unsaturated acids, %	54,78	53,34	P<0,01
Polyunsaturated acids, %	19,39	18,10	P<0,20
Monounsaturated acids, %	35,39	35,24	NS
P/S ratio	0,43	0,39	P<0,10
Unsaturated trans acids	2,04	1,80	P<0,10

As a foodstuff, milk has an outstanding role in human nutrition and its products being remarkably important, too, on grounds of their proven health effects. Visible differences in milk yield and in its quality among some breeds ought to be accentuated. Thus, the autochthonous breeds of livestock (Busha and Podolian) are characterised by a low yield (1000-2000kg), but also by a high lactic acid content (4.5-5%) as corroborated by the results of Bodo (1996). Lactic acid contains numerous anti-cancerous matters, such as conjugated linoleic acid accounting for 2.4-28.1 mg/g (Parodi, 1999).

In addition to meat production, sheep breeding has increasingly focused on milk production. Milkiness of some of the strains of Zackel has been found to range from 77 kg (Pirot Zackel) to 148 kg (White Metohian) with 7% lactic fat. Sheep milk ought to be emphasized as an important product of the commercially valuable highlands and as a major raw matter used for milk processing and cheese production (sjenicki, zlatarski, pirotski, caciocavallo and others).

Milk produced of goats and its processing are of vital importance to the highlands where foodstuffs are, as a rule, in short supplies.

As far as egg quality, i.e. the variability level of the autochthonous hen flocks is concerned, the obtained data can be seen in the tab.9.

Tab.8. Milk production of Hungarian Grey cattle (Bodo et al., 1996)

No of cows	50	49	60
Days of milking	189	232	247
Milk production, kg	1611	1733	1963
Lactic fat production, kg	70,4	81,3	93,0
Fat content, %	4,4	4,7	4,7

Tab.9. Egg quality in the autochthonous hens (n=40) (Tolimar Natasha et al., 1997)

Characteristic	Flock	x	CV	MIN-MAX		Significant differences
Roche Yolk colour	1	14,67	3,57	13	15	1-3:0,75***
						1-4:1,12***
	2	14,74	3,12	14	15	1-5:0.37**
						2-3:0.82***
	3	13,92	6,32	12	15	2-4:1,19***
						2-5:0.44**
	4	13,55	8,57	11	15	5-3:0.38*
						5-4:0.75***
	5	14,30	4,74	12	15	
Albumen height 0,1mm	1	66,27	18,17	33	85	1-2:5.33*
						4-2:8.53**
	2	60,74	17,45	41	83	5-2:8.93**
						4-3:6.55*
	3	62,72	22,88	33	92	5-3:6,95*
	4	69,27	18,41	40	92	
	5	69,67	18,67	47	105	
Haugh units	1	81,92	5,59	61	94	1-2:4,28*
						1-3:5.57**
	2	77,64	10,03	62	93	4-2:4.63*
						5-2:5.73**
	3	76,35	14,25	50	94	4-3:5,92**
						5-3:7.02**
	4	82,27	10,05	63	97	
	5	83,37	9,85	69	101	
Shell thickness 0,01mm	1	33,10	8,10	26	39	3-1:2.30***
						3-2:1.71**
	2	33,69	9,26	27	39	3-4:1.40*
						3-5:1.90**
	3	35,40	6,92	30	41	
	4	34,00	9,05	27	43	
	5	33,50	10,66	25	41	

* P< 0.05; **P< 0.01; ***P>0.001

Based on the results on egg quality obtained from 5 flocks of the autochthonous hen flocks of different phenotypic traits, the statistically significant differences in all the traits among the flocks were established. Likewise, the traits on egg quality seemed to be differing in the autochthonous hens when compared with the literature data related to the hybrid laying hens used in industrial production.

The livestock and hens reared in open buildings, outlets and pastures, where the animals could spend most of time in the sun breathing fresh air thus consuming natural feeds, may undoubtedly ensure the high quality meat, milk and eggs used for products which are traditionally highly demanded on the market. The Pirot, Svrljig and Sjenica lambs, inland hens and eggs, traditional Mangaltsa, Moravka and Resavka (smoked ham, loin, salami) meat and milk (pirotski caciocavallo, sjenincki cheese and kraljevacki kajmak) products are largely preferred on the markets of Macedonia, Croatia, Slovenia, Greece, Italy, Germany and in the remaining EU countries, too. On the other hand, these products retain rights not to be copied, then, they must meet particular standards and are labeled with accurate data about producer, origin and producing technology.

Conclusion

A detailed analysis made on the cattle rearing system and animal genetic resources as to be optimally utilised in the future production could be defined as the paper's objective including the following:

- the need for more intensive livestock production boom has come into being fully in recent years since the industrial production principles imperiled animal health and behaviour and largely lowered meat, milk and egg quality;
- the demand for numerous cattle and poultry breeds having a significant role in the economy of Serbia, particularly for traditionally known meat and milk products enormously demanded on the market in and out of the country, and
- animal genetic resources, as the valuable genetic material ought to be appropriately preserved and upgraded. Lastly, the existing genetic resources also seem to be necessary included in the cattle production systems.

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SISTEMI PROIZVODNJE U STOČARSTVU, OČUVANJE I KORIŠĆENJE ANIMALNIH GENETIČKIH RESURSA

- pregledni rad -

Gajic, Ž.
Poljoprivredni fakultet, Beograd

Bogosavljevic-Boškovic Snežana
Agronomski fakultet, Čačak

Pušić M.
Centar za primenu nauke u poljoprivredi, Beograd

Mitrović S.
Poljoprivredni fakultet, Beograd

Rezime

U radu su istaknute značajne promene u sistemima stočarske proizvodnje, a posebno je naglašen značaj i strategija očuvanja korišćenja i unapređenja animalnih genetskih resursa u Srbiji. Pored očuvanja postojećeg biodiverziteta, obezbedilo bi se bolje korišćenje genetskog potencijala autohtonih rasa i sojeva stoke i zivine u proizvodnji prirodno zdrave hrane, pojefinjenja proizvodnog procesa kao i zaštite zivotne sredine.