

HU-BA system: a Hungarian model to conserve and take the advantage of traditional poultry genetic resources

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Introduction: Background and short overview of HU-BA system

History of traditional Hungarian poultry genetic resources, including several chicken, turkey, guinea-fowl, goose and duck breeds demonstrate their important role in family farming of the Carpathian Basin. As the expansion of poultry industry made traditional breeds gradually disappear from the countryside, Hungarian conservation programs started in the form of governmental subsidies in the beginning of 1970's to maintain original stocks of certain rare local poultry breeds and varieties. Since 1997 conservation of traditional Hungarian poultry breeds is organized and controlled by an NGO: the Association of Hungarian Small Animal Breeders for Gene Conservation (MGE), which is the only official breeding organization for all poultry genetic resources in the country.

Conservation of local breeds through the development of different ecological types of production systems and products have real importance in maintaining agro-biodiversity and agro-ecosystems. In this process, local poultry breeds should play a significant role, even in the near future. To achieve this goal, the HU-BA system has been elaborated, aiming to combine conservation activities and utilization of the traditional Hungarian poultry breeds. The name HU-BA represents two meanings: the leader of one of the 7 tribes conquering the Carpathian Basin in the late 9th century was called HUBA. On the other hand, HU-BA is coming from the abbreviation of the Hungarian phrase: "Hungarikum baromfitermékek", means very special Hungarian (Hungarikum) poultry products, referring therefore in two ways to the Hungarian traditions and ancientness.

In the following chapters, main elements of the HU-BA system will be discussed, starting with the gene conservation program of traditional Hungarian poultry breeds as genetic bases of the system, followed by the propagation of breeding stocks by functional in situ gene banks, and finished by the evaluation of production characteristics for a strictly controlled production and marketing by different types and sizes of farms in different countries, including the HU-BA model village program in Hungary and HU-BA adaptation studies in Vietnam.

Main elements of HU-BA system

Traditional poultry breeds of the Carpathian Basin

Historically, the most famous poultry breeds of the Carpathian Basin are the Transylvanian Naked-neck Chicken and the Frizzled Hungarian Goose, often referred to as "Hungarikum" poultry breeds, and believed to be characteristic only for this

region. Three domestic bird species, chicken, goose and turkey are listed by Bartosiewicz (2002) as having autochthonous breeds in Hungary, however, according to the archaeozoological records the idea of direct continuity between ancient birds and the modern autochthonous ones would be difficult to accept. Characterizing the Hungarian activities on the conservation of domestic animal genetic resources, Bodó (1985) listed only the Speckled, Yellow, White and two color varieties of Naked-Neck (black and speckled) chicken, and the Frizzled Feather Goose, as old Hungarian poultry breeds threatened by extinction, and which deserve consideration as genetic resources. Within the species of domestic fowl in Hungary, Bodó et al. (1990) considered for preservation the White, Yellow and Speckled Hungarian Chicken mentioning their naked-neck variety, and the Transylvanian Naked-neck, similar to the above variants, but having different origin. By developing conservation activity and setting up in situ gene banks for traditional poultry breeds in Hungary, it was made clear, that there are two more species (duck and guinea-fowl), and several breeds and varieties of other species having long breeding history in the Carpathian Basin (Szalay et al, 1992; Szalay et al., 1995; Szalay, 2002). At present, traditional poultry breeds, registered and protected for their genetic value in Hungary are represented by seven breeds of chicken, distinguished by their plumage color, two breeds of turkey, one landrace type of Guinea-fowl, Hungarian goose breeds, distinguished by color and feather varieties and Hungarian Duck color varieties. The following paragraphs provide some more information on the breeds by species:

Hungarian chicken breeds. Until the beginning of commercial chicken breeding Hungarian chicken breeds of different colours (white, speckled, yellow, partridge-colour and naked neck variants) were widespread in the country. They were preferred here not only for their relatively good egg production under harsh conditions, but for their excellent meat quality coming from the "seeking habit" of these birds, scratching for food regardless of hot or cold weather. Starting in the 1960s, breeding programmes and production of local breeds were replaced by commercial chicken hybrids, resulting in fast decrease of the population number of old Hungarian chicken breeds. Since 1973, majority of breeds and colour varieties had been maintained as official gene reserves. In 1991, based on historical literature on Hungarian poultry breed standards, Transylvanian Naked-neck chicken was declared to be an independent breed represented by colour varieties: white speckled and black, while White, Speckled and Yellow Hungarian chicken breeds having no naked-neck varieties. Since 1997, all breeds and colour varieties have been conserved as individual breeds. In 2004 – following a long time field study, collection and breeding work, the Partridge-colour Hungarian Chicken was redeveloped, making the seventh chicken breed in conservation.

Hungarian turkey. Turkey breeding has existed in the Carpathian basin for many centuries. In Hungary, white and black colour variants of turkey were known. Later the black variety practically disappeared after crossing with Bronze and other turkey breeds, import of which started in the second half of the 19th century. As the result of crossings, however, Bronze turkey became adapted to the local conditions and it is considered now as an old Hungarian poultry breed. Copper turkey used to be popular in the southern part of Hungary. Body weight of the breed is somewhat lower than that of other turkey breeds, however, it is a very strong, resistant to diseases and well adapted local breed.

Guinea-fowl. Landrace varieties of guinea-fowl include bluish-grey (the most popular colour variety), white, grey, bronze or black and spotted. First reports about guinea-fowl breeding and production in Hungary were published at the beginning of the 20th century, though it must have been introduced into the Carpathian basin much earlier and was kept as a game bird or a semi-domesticated animal around manor-houses and monasteries. Meat quality, high adaptability to different conditions, disease resistance, wild nature, seeking habit and low keeping costs make guinea-fowl an excellent poultry species for ecological type production.

Hungarian goose and its frizzled variant. Hungarian goose is indigenous in the Carpathian basin. During the centuries it has got used to the special climatic conditions and farming systems of the region, which made it very precious in this part of Europe. Local goose breeds of different colours (white, greyish or spotted) produced high quality fatty liver, meat and feather approved by all markets. A unique variety of Hungarian goose – the Frizzled Hungarian goose – is considered now as a typical poultry breed for the Carpathian basin. Frizzling (F) is a mutant gene which causes the contour feathers to curve outward away from the body. Colour variants are white, grey or white-grey spotted.

Hungarian duck. The original Hungarian duck considered as an indigenous breed in the Carpathian basin used to be found mostly in white and wild, rarely in spotted, brown or black colour varieties. Because of its juicy, delicious meat, Hungarian duck was bred all over the country being more important for domestic consumption than goose. Nevertheless, starting with the early 1960s, Hungarian duck gradually disappeared as the result of crossing with imported duck breeds. Conservation programme of local duck varieties (white and wild-colour) started in the late 1990s with the populations originated from Southeast Hungary and Transylvania.

More details about the history, breeding principles and standard characteristics of the breeds are found in a book on old Hungarian poultry (Szalay, 2002), in a recent electronic paper (Szalay et al., 2009), and on the website of MGE (www.mge-hu.com).

Official gene conservation programs

Poultry conservation programs are implemented for several indigenous, native or adapted poultry breeds in Hungary, including local chicken breeds and varieties, color varieties of landrace turkey and guinea-fowl, local varieties of domestic goose and duck. AnGR conservation is supervised and partly financed by the Ministry of Agriculture and Rural Development and the Animal Breeding Directorate of the Central Agricultural Office (MGSzH). Hungarian poultry conservation is coordinated and organized by the Association of Hungarian Small Animal Breeders for Gene Conservation (MGE) as a non-governmental organization (NGO), founded in 1997. Conservation programs of elite stocks are carried out by breeding institutions having several decades of experience, including: Debrecen University (Copper and Bronze Turkey; Mihók, 2004), West-Hungarian University, Mosonmagyaróvár (Yellow Hungarian Chicken; Kovácsné Gaál, 2004), Szeged University of Science, Hódmezővásárhely (Speckled Hungarian and Speckled Transylvanian Naked-neck Chicken; Sófalvy, 2005), and the Research Institute for Animal Breeding and Nutrition, Division of Small Animal Research (ATK-KATKI Godollo Poultry Gene Bank includes all registered traditional poultry breeds: 7 chicken, 2 turkey, 2 goose 1

guinea-fowl and 2 duck breeds; Szalay, 2004). During the 10 year history of MGE, conservation basis has been expanded, as several farmers and breeders joined the group of Hungarian poultry conservation network. The main result of the growing conservation network is the stabilized number of breeders in poultry elite stocks in the recent years, conserved as officially registered breeds. In all breeds effective population size exceeds the critical level ($N_e \geq 100$) proposed for conservation of animal genetic resources (Foote, 1983). Calculation of effective population size depending on the number of breeding males and females is given in Table 1.

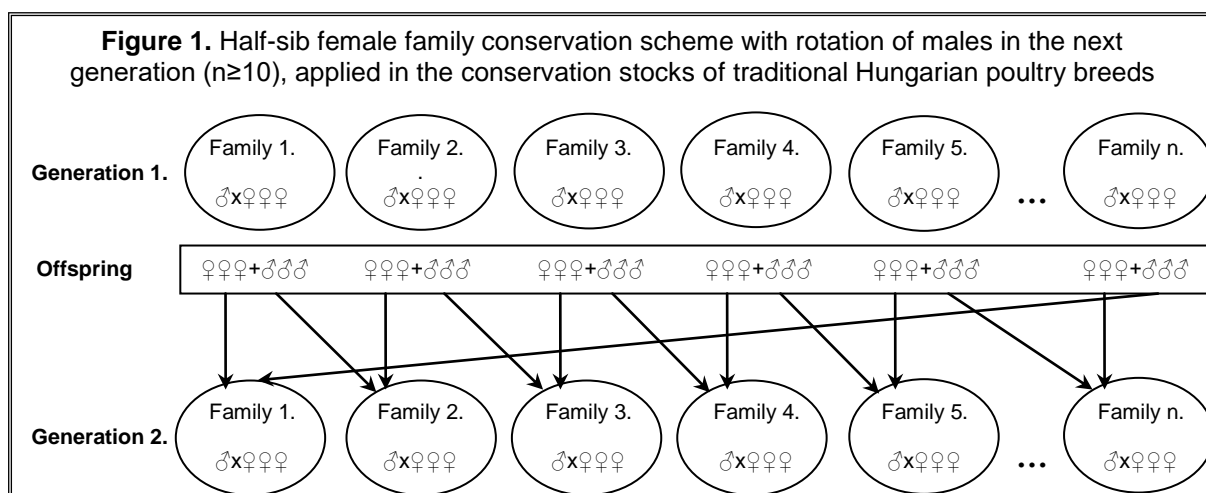
$$N_e \text{ was calculated according to the equation (after Wright, 1931): } N_e = \frac{4N_f N_m}{N_f + N_m},$$

where N_e : effective population size; N_f : number of dams; N_m : number of sires.

Number of breeding males	Number of breeding females										
	4	10	20	30	40	50	60	80	100	200	500
	Effective population size										
1	3	4	4	4	4	4	4	4	4	4	4
2	3	7	7	8	8	8	8	8	8	8	8
4	8	11	13	14	15	15	15	15	15	16	16
10	11	20	27	30	32	34	36	36	36	38	39
20	13	27	40	48	53	57	60	64	67	72	77
50	15	33	57	75	89	100	109	123	133	160	182
100	15	36	67	92	114	133	150	178	200	267	333

Main regulations of MGE conservation programs of elite stocks of traditional Hungarian poultry breeds are as follows:

- Egg collection is made around peak production from at least 10 half-sib female families with rotation of the males in the next generation (Figure 1). Trap-nests are used if available.
- Changing the set of males (reserve males) in the mid of egg collection.
- Maintaining low sire/dam ratio: 1/7 for chicken, 1/5 for guinea fowl, and 1/4 for turkey, duck and goose.
- Pedigree hatching and wing-banding are done by families;
- Rearing and egg production conditions are free range, according to the rules of organic farming.
- One year old birds are kept for the following year as registered reserve flocks.
- Limited phenotypic selection is allowed among males.



Developing functional *in situ* gene banks

Expansion of commercial poultry breeding and production was followed by the dramatic decrease in poultry diversity. By the beginning of 1970ies, the role of landrace types of poultry were taken over by commercial breeds even in the rural households, and breeding programs for local breeds ceased in a short term. In Hungary governmentally managed conservation programs for certain poultry breeds and varieties started in 1973, which enabled to preserve certain breeding stocks of chicken. Official list of conserved breeds included Yellow, Speckled and White Hungarian Chicken, color varieties of Transylvanian Naked Neck Chicken, Bronze and Copper Turkey and Frizzled Hungarian Goose. Based on these stocks, the breeds has survived in functional gene banks serving as primary breeding centers, providing hatching eggs and day old chicks mainly for family farms. Lately, functional gene bank stocks of additional local breeds have been developed and registered, for which starting populations were collected in different rural regions of the Carpathian Basin where traditional family farming still exists (Hungarian goose and duck varieties, Partridge-color Hungarian chicken). *Functional in situ gene banks* of old Hungarian poultry breeds allow the primary breeders to offer grandparent and parent stocks for sale, providing the chance to elaborate breeding and production systems analogous to commercial ones.

Table 2 shows the theoretical propagation scheme of HU-BA poultry breeds by species in five years. Note, that the number of offspring is calculated for the breeding cycles of breeds in Hungarian conditions of gene banks.

TABLE 2. THE THEORETICAL PROPAGATION SCHEME OF HU-BA POULTRY BREEDS BY SPECIES BETWEEN 2010-2014					
HU-BA chicken: 60 offspring/year, 5 offspring for breeding (elite-grandparent)					
<i>Breeding level</i>	<i>Years</i>				
	<i>2010</i>	<i>2011</i>	<i>2012</i>	<i>2013</i>	<i>2014</i>
Elite (number)	1 000	1 000	1 000	1 000	1 000
Grandparent (number)	0	4 000	4 000	4 000	4 000
Parent (number)	0	17 500	20 000	20 000	20 000
End product (number)	37 500	1 325 000	1 475 000	1 475 000	1 475 000

HU-BA GUINEA-FOWL: 40 OFFSPRING/YEAR, 5 OFFSPRING FOR BREEDING (ELITE-GRANDPARENT)					
<i>Breeding level</i>	Years				
	2010	2011	2012	2013	2014
Elite (number)	300	300	300	300	300
Grandparent (number)	0	1 200	1 200	1 200	1 200
Parent (number)	0	5 250	6 000	6 000	6 000
End product (number)	5 250	262 500	292 500	292 500	292 500

HU-BA TURKEY: 20 OFFSPRING/YEAR, 5 OFFSPRING FOR BREEDING (ELITE-GRANDPARENT)					
<i>Breeding level</i>	Years				
	2010	2011	2012	2013	2014
Elite (number)	200	200	200	200	200
Grandparent (number)	0	800	800	800	800
Parent (number)	0	1 500	4 000	4 000	4 000
End product (number)	1 500	45 000	95 000	95 000	95 000

HU-BA DUCK: 40 OFFSPRING/YEAR, 5 OFFSPRING FOR BREEDING (ELITE-GRANDPARENT)					
<i>Breeding level</i>	Years				
	2010	2011	2012	2013	2014
Elite (number)	150	150	150	150	150
Grandparent (number)	0	600	600	600	600
Parent (number)	0	2 625	3 000	3 000	3 000
End product (number)	2 625	131 250	146 250	146 250	146 250

HU-BA GOOSE: 40 OFFSPRING/YEAR, 5 OFFSPRING FOR BREEDING (ELITE-GRANDPARENT)					
<i>Breeding level</i>	Years				
	2010	2011	2012	2013	2014
Elite (number)	200	200	200	200	200
Grandparent (number)	0	800	800	800	800
Parent (number)	0	1 500	4 000	4 000	4 000
End product (number)	1 500	45 000	95 000	95 000	95 000

Assessment of production characteristics of the breeds and their crosses

Long term gene conservation of rare domestic animal breeds can be achieved only if they are utilized economically in production. For use, however, exact data on production and reproduction traits of the breeds should be known. In the present study the results of the trials on some production and reproduction traits of old Hungarian poultry breeds and their crosses are shown. The experiments were carried out in 2005 and 2006 in the Poultry Gene Bank farm of the ATK-KATKI in Godollo with landrace type Hungarian goose and its frizzle feathered variant (LG), Hungarian Upgraded goose (UG), four Hungarian and three Transylvanian Naked-neck chicken breeds and varieties and Hungarian turkey breeds (Bronze turkey: BT and Copper turkey: CT). Some crosses between breeds were also examined. Egg production, fertility and hatchability, body weight gain (in every 2 weeks), slaughter traits (live

weight, weight after slaughter, slaughter/live weight %, breast weight, thigh weight, breast+thigh weight/slaughter weight %) and feed conversion were measured. Egg production records of the two goose breeds show that LG male × UG female cross can be economic for the production of crossbred offspring. Hatchability rate from crossing is higher than that of both parent breeds. White Transylvanian Naked Neck Chicken ♂ × Partridge-color Hungarian Chicken ♀ was found to be the best cross for *Hungaricum* (HU-BA) chicken meat production. Heterosis was found in body weight until 10 weeks of age. As regards turkey breeds, CT ♂ × BT ♀ cross produced more progenies and showed higher body weight than the reciprocal cross, therefore this cross is proposed for HU-BA production system in turkey. All results were obtained in free range conditions. The project was financed by the National Office for Research and Technology and completed by ATK-KATKI and MGE in Godollo, in 2005-2008 (Bódi et al, 2007; Szalay et al, 2007).

Sustainable production technologies for HU-BA system

Parallel with agricultural policy of EU and related national programs intended to develop agriculture in a multifunctional and sustainable way, poultry conservationists seem to have good chance for using poultry genetic resources in alternative production systems. To prove advantages of old breeds, and to show their role in returning to sustainable agriculture, appropriate research with traditional poultry breeds and alternative production systems are of major importance.

Organic (in Hungarian use: *ecological*) *farming* should offer a considerable background for the use of local domestic animal breeds in certain countries, where functionality of conservation stocks has been sustained, as revealed by a recent survey in the CHANNEL project for Slovenia and Hungary (Radics et al, 2006). For their short return period, poultry breeds can be an important share of organic production both in specialized for poultry production and mixed farms. Functional gene banks are the main sources to supply organic farms with animals needed for low input organic production. The low production level of organic poultry certainly will rise in the Carpathian basin, as many of family farms with good facilities for poultry keeping will extend over their production to the market.

As part of the conservation program, MGE and its institutional partners have been working on the elaboration of the genetic bases, management and quality control of production of the *Hungaricum* type quality poultry products. Special poultry production needs old Hungarian type poultry breeds, natural or ecological production and a comprehensive controlling system, by which typical Hungarian product, called *HU-BA* can be produced. Further important aspects of HU-BA production are conservation of old Hungarian poultry breeds and breeding traditions, as well as rural family farming. Making HU-BA products more marketable, inclusion of ecological type mixed farming in production is very promising, if incorporation of poultry production into ecological plant cultures or horticultures is solved. This type of production can provide a model for the development of ecological type mixed farming systems including poultry, for other countries too.

HU-BA Model Villages: Reintroduction of traditional poultry breeds to the rural areas

Family poultry production has got a long history in all over the world; however, urbanization and lifestyle changes together with the “poultry boom” resulted in a significant decline in the number of families keeping poultry for self consumption. Decline started much later in countries in transition, while the most important source of meat and egg in rural regions of developing countries are still the household units. Family poultry production in the Carpathian Basin is still important in rural sites, representing about 20% of all production (Horn et al., 2002), depending on the level of urbanization and industrialization of the region. Village poultry is also the source of genetic resources in many cases, as some traditional landrace goose and duck varieties have been collected in marginal rural areas and maintained in gene banks by MGE breeders. The majority of villages, however, have lost their characteristic local poultry breeds, and mostly intensive hybrids are kept by households. As a new program launched by MGE, voluntary model villages are provided with hatching eggs or day old chicks from the gene banks of old Hungarian poultry free of charge. The only obligation of the households of model villages in the program is to keep and reproduce the birds the following year, and possibly supply families of another village with the offspring under the coordination of the breeding association and primary breeders. Additional goals of the reintroduction program are not only the widened background of gene conservation of old breeds and the use local breeds in suitable conditions, but also the possible breeding basis for production of village poultry, organic or HU-BA poultry. Providing additional incentives and culinary choices, model villages of local poultry can play a considerable role in rural tourism development as well.

Conclusions

Conservation of local breeds (both plants and animals) through the development of different ecological type of production systems and products have real importance in maintaining agro-biodiversity and agro-ecosystems. In this process, local poultry breeds should play a significant role, even in the near future. To achieve this goal, the HU-BA system seems to be a proper solution either in Hungary, or – following proper adaptation experiments and rural surveys – in Southeast Asian countries.

Selected long term results of the operation of HU-BA system can be listed as follows:

- Premium quality and traditional poultry products.
- Long term and safe basis for gene conservation.
- Redeveloping family poultry production in rural areas.
- Sustainability and agricultural development in marginal regions.

References

- Bartosiewicz, L. (2006) Are “autochthonous” animal breeds living monuments? In E. Jerem – Zs. Mester – R. Benczes eds. Archaeological and cultural heritage preservation within the light of new technologies. Archaeolingua, Budapest. 33-47 p.
- Bódi, L., Dong Xuan, K.D.T. and Szalay I.T. (2007) HU-BA production system for special poultry products in Hungary. Proc. 5th Vietnamese-Hungarian International Conference on Animal Production and Aquaculture for Sustainable Farming, Can Tho University, Can Tho, Vietnam, 11-15 August, 2007. 61-65 p. www.mge-hu.com
- Bodó, I. (1985) Hungarian activities on the conservation of domestic animal genetic resources. AGRI 4:19-25.
- Bodó, I., Kovacs, G. and Ludrovsky, F. (1990) The Naked Neck Fowl. AGRI 7:83-88.
- Dong Xuan, K.D.T. and Szalay, I. (2003) Possibilities and aspects to introduce foreign poultry genetic resources to Central Vietnam. Proc. 3. Vietnamese-Hungarian Conference „Domestic animal production and aquaculture – Quality and rural development” pp. 47-54.
- Dong Xuan, K.D.T., Szalay, I., Su, V.V., Tieu, H.V. and Dang Vang, N. (2006) Animal genetic resources and traditional farming in Vietnam. AGRI 38:1-17.
- Dong Xuan, K.D.T., Szalay, I.T., Duc Tien, P. and Minh Thu, P.T. (2007) Adaptation experiments of Hungarian turkey breeds and their crosses in Vietnam (MGE-NEFE project, Hungary–Vietnam, 2006-2007). Proc. 5th Vietnamese-Hungarian International Conference on Animal Production and Aquaculture for Sustainable Farming, Can Tho University, Can Tho, Vietnam, 11-15 August, 2007. 33-41 p. www.mge-hu.com
- Dong Xuan, K.D.T., Szalay, I.T., Duc Tien, P., Minh Thu, P.T. and Dang Vang, N. (2008) Adaptation of old Hungarian poultry breeds in South-East Asia. An Alternative way of conservation. Proc. 7th Global Conference on the Conservation of Animal Genetic Resources, Hanoi, Vietnam, 14-18 September, 2008 pp. 13-18.
- Foose, T.J. (1983) The relevance of captive populations to the conservation of biotic diversity. Genetics and Conservation, edited by C.M. Schonewald, Cox, S.M. Chambers, B. MacBryde and L. Thomas; 374–402. p.
- Horn, P. Foldi, P., Bastek, V. and Luksanova, P. (2002): Poultry production in the Czech Republic, Hungary and Slovakia. 11th European Poultry Conference 6-10 September 2002 Bremen, Germany. CD ROM
- Kovácsné Gaál K. (2004) A sárga magyar tyúk génmegőrzése és fajtafenntartása Mosonmagyaróváron. [Gene conservation and breeding of the Yellow Hungarian Chicken in Mosonmagyaróvár. In Hungarian] A Baromfi 7(1):21-24. www.mge-hu.com
- Mihók S. (2004) Őshonos és réghonosult baromfifajok fenntartása a Debreceni Agrártudományi Centrumban. [Conservation of indigenous and adapted poultry species in the Centre of Agricultural Science of the Debrecen University. In Hungarian]. A Baromfi 7(2):8-13.
- Radics, L. (ed.) (2006) Summarised results of CHANNEL project. Szaktudás Publishing, Budapest. www.channel.uni-corvinus.hu

Szalay IT – Dong Xuan KDT (2009) HU-BA system: a Hungarian model to conserve and take the advantage of traditional poultry genetic resources. Tap Huan Ky Thuat Chan Nuoi Ga Tay – Proc. Vietnamese Turkey Breeding Conference, Cam Binh, Vietnam, 15 October, 2009. pp. 56-64.

- Sófalvy F. (2005) Az őshonos kendermagos magyar tyúk tartása Hódmezővásárhelyen [Conservation of the indigenous Speckled Hungarian Chicken in Hódmezővásárhely. In Hungarian]. A Baromfi 8(1):4-13.
- Szalay, I. (2002) Régi magyar baromfifajták. Old Hungarian Poultry. (In Hungarian and English) Mezőgazda Publishing, Budapest. 111 p.
- Szalay I. (2004) A régi magyar baromfifajták tenyésztése és génvédelme a KÁTKI-ban. [Breeding and conservation of old Hungarian poultry breeds in KATKI. In Hungarian]. A Baromfi 7(3):22-25.
- Szalay, I., Biszkup, F., Barta, I. and Koppány, G. (1992) Present status of the native Hungarian chicken breeds. In: L. Lawrence and I. Bodó (ed.) Genetic Conservation of Domestic Livestock. Vol. 2., Chapter 22. C.A.B. International, Wallingford, UK. 223-231. p.
- Szalay, I., Biszkup, F., Barta, I., Barna, J. and Koppány, G. (1995) Protected Hungarian chicken breeds. In: Conservation of Domestic Animal Genetic Resources. Ed: R.D. Crawford, E.E. Lister and J.T. Buckley. (Proc. Third Global Conference on Domestic Animal Genetic Resources, Kingston, Canada), Rare Breeds International. 278-280. p.
- Szalay, I.T. and Dong Xuan, K.D.T. (2007) Sustainability and gene conservation as guiding principles of the Hungarian-Vietnamese poultry research for development. Proc. 5th Vietnamese-Hungarian International Conference on Animal Production and Aquaculture for Sustainable Farming, Can Tho University, Can Tho, Vietnam, 11-15 August, 2007. 21-25 p. www.mge-hu.com
- Szalay, I., Bódi, L., Dong Xuan, K.D.T., Szentes, K., Barta, I., Stompné Molnár, I., Kustos, K. and Horel, K. (2007) A hungarikum baromfihús termelési rendszerének kidolgozása – a projekt 2006. évi gödöllői eredményeinek összefoglalása. [Elaboration of the production system for special quality Hungaricum poultry products – summarised results of the project obtained in Gödöllő in 2006. In Hungarian, with English summary] A Baromfi (Baromfitudomány) 10(1):34-47. www.mge-hu.com
- Szalay I., Kisné Do thi Dong Xuan, Virág Gy., Szentes K.Á., Bódi L. (2009) Prospects for conserving traditional poultry breeds of the Carpathian Basin. AWETH 5(2):119-148. <http://www.animalwelfare.szie.hu/cikkek/200902/AWETH2009119148.pdf>
- Wright, S. (1931) Evolution in Mendelian populations. Genetics 16:97-159.