POULTRY GENETIC RESOURCES USED BY SMALL PRODUCERS[*1]

M. A. Kosba[1], H. M. Yakout[1], T. A. Ebeid[2], A. Abd El-Azeem[3], Z. H. Shikhon[4], O. Thieme[5], and Z. S. Ahmed[6]

[1]Poultry Production Department, Fac. of Agric., Alexandria Univ.,
[2]Poultry Production Department, Fac. of Agric., Tanta Univ.,
[3]Poultry Production Department, Fac. of Agric., Fayoum Univ.,
[4]Animal Production Department, Fac. of Agric., Sohag Univ.,
[5]FAO, Animal Production and Health Division, Rome, Italy,
[6]FAO, Emergency Centre for Transboundary Animal Diseases (ECTAD), Cairo, Egypt

Abstract: The livestock sector forms an essential component of the agricultural output in both the developed and developing world. Of the animal species used, poultry considerably contribute to the total food and agricultural production. However, with increasing loss of genetic diversity that has been observed for all agriculturally used species, poultry genetic resources are considered to be one of the most endangered. In order to conserve poultry genetic resources, basic information about local poultry populations has to be established. This has been conducted in some countries worldwide, but the actual situation of these populations under field conditions is less known, Egypt is considered one of these countries. Characterization provides data on present and potential future uses of these local poultry populations and establishes their current state as distinct breed populations and their risk status. Data on production systems, phenotypes and molecular markers are used altogether in an integrated approach to characterization. On the other hand, transboundary animal zoonotic disease is considered an ongoing growing problem, which particularly affects poultry producers and rural societies in developing countries and endangers poultry genetic resources. In Egypt, since the onset of Highly Pathogenic Avian Influenza (HPAI) in February, 2006, the Egyptian government is making continuous efforts to control the disease. During the control process an estimated 30 million birds were culled, and more recently there has been widespread vaccination of private commercial sector and some of backyard poultry. In this paper, we discuss current activities and prospects to evaluate existing diversity in poultry, study the characterization of phenotypic characters of *Baladi* chickens and ducks at three Egyptian governorates as initiated and guided by FAO. Methodological approaches, along with modern techniques, and potentials of modern biotechnological methods are tools to identify, characterize and conserve genetic resources.

Key words: *poultry genetic resources, phenotypic characters, conservation, Baladi chickens and ducks*

[*1]The Government of Germany funded this study through the FAO project "Promoting strategies for prevention and control of HPAI that focus on smallholder livelihoods and biodiversity" (GCP/INT/010/GER).

Introduction:

The livestock sector forms an essential component of the agricultural output in both the developed and developing world. Of the animal species used, poultry considerably contribute to the total food and agricultural production for meat production. In 2002, FAO estimated the total meat production to be 245 million tons, and about 30% thereof was poultry meat, mainly from chickens. More than half of this was produced in developing countries. For eggs, developing countries' portion of the total production is even higher.

Furthermore, unlike other farm animals such as cattle, poultry and in particular chickens play an important role in the small holder farming systems in developing countries. Quite often local poultry stocks serve as major source of animal protein to the poor, since they are accessible even to landless households (Weigend, *et al.*, 2004)

During the last couple of decades animal production has significantly increased, with a significant increase of the global use of highly productive breeds of farm animals. However, the downside is that increased global use of highly productive breeds has lead to a loss of genetic diversity in most species of farm animals. Both genetic diversity within breeds and genetic diversity between breeds are under pressure. As a result, original indigenous breeds are often replaced by globally used high productive breeds. This decline in the genetic diversity of farm animal genetic resources (AnGR) is now widely recognized. Thus, many countries have signed the Convention on Biological Diversity (CBD, 1992) and have since established policies toward conservation and sustainable use of animal and plant genetic resources. Noticeably, less popular breeds are often maintained only locally and in small populations by low-income families. Consequently, these breeds are at risk for becoming extinct or may suffer from inbreeding and genetic drift (Woelders, *et al.*, 2006).

With this in mind, many reports have also shown that over the past three decades, a considerable portion of avian genetic stocks has disappeared (Pisenti *et al.*, 1999; Fulton and Delany, 2003). The current status of preservation, which must utilize live animal stocks, has acted as a factor, among many others, that contributed to the loss of genetic resources (Fulton, 2006). Nevertheless, in most of the developing countries, local governments are under permanent pressure of global animal breeders to change for intensive production, which can be characterized as "simple minded on profit" (Hodges, 2006). Regrettably, many of old domestic animal breeds have now become extinct, or have got into extreme danger: 35.6% among mammals and 63.5% among poultry (FAO, 2000). A good explanation of the loss in genetic diversity is that, about 40 species of livestock and birds have been domesticated worldwide. Nowadays, the majority of all poultry breeds are only found in 5 species (chicken, duck, turkey, goose and guinea fowl). Within those species, there have been about 1,000 avian breeds, providing a huge pool of genetic diversity (Szalay and Dong Xuan, 2007).

Conservation and sustainability are keys elements to maintain appropriate and diverse gene pool. Sustainable use of animal genetic resources for agriculture and food production (AnGR) is proposed as the best strategy for maintaining livestock diversity. Conservation is important, as it is a way for maintaining rare or local breeds, and also local breeds are viewed as cultural heritage. However, with respect to

the more widely used breeds, it is necessary to preserve genetic diversity. We need genetic diversity as a toolbox for continued breeding. This is especially true in the situation where future breeding goals are different from those of today (Woelders, *et al.*, 2006). Furthermore, sustainable use of agricultural resources can only be achieved with the conservation of traditional local domestic animal breeds as part of local agro-biodiversity. Traditional mixed farming in developing countries meets these requirements, while ecological (organic) type farming in developed countries tries to meet these demands, in the latter case though, creating new traditions for the lost ones is not an easy task.

Inventory of species and breeds, their population sizes, geographic distribution and possibly their genetic diversity is generally undertaken as a first step in any national program for the management of animal genetic resources for food and agriculture. This assessment is conducted to document the current state of knowledge in terms of a population's ability to survive, reproduce, produce and provide services to farmers. Inventory and characterization are, therefore, complementary processes, in which the characterization step provides the baseline information as well as the criteria that will be used to establish and update the inventory. The use and management of animal genetic resources are dynamic processes, monitoring the status of a population has to be done on a regular basis. Thus, risk status indicators for use during the monitoring process need to be defined following the inventory and characterization steps.

The FAO project "Promoting strategies for prevention and control of highly pathogenic avian influenza (HPAI)" focuses on the affects of avian influenza control on smallholder livelihoods and biodiversity" (GCP/INT/010/GER). Poultry genetic diversity is one of the three components of the project along with animal health and livelihoods. While basic information about local poultry populations has been established in many countries including Egypt, the actual field conditions of these populations is less known. The Egyptian poultry genetic populations have been categorized as traditional (Tixier-Boichard et al., 2008) with local origin and birds that are considered adapted to their environment. They are managed by the farmers with low selection intensity, are also affected by natural selection and often exhibit a large phenotypic diversity (particularly for coat or plumage color). Their genetic structure is mainly influenced by migration events and mutations, which would generally be counter selected in the wild.

In this paper, we discuss current activities and prospects to evaluate existing diversity in poultry by studying phenotypic characters of *Baladi* chickens and ducks in three Egyptian governorates (Al-Gharbya, Al-Fayoum and Sohag). through methodological approaches, along with modern techniques and biotechnological methods.

Materials and Methods

Data were collected from August until November, 2008 to characterize *Baladi* chickens and ducks in villages of the three Governorates. Qualitative and quantitative methods of research were used, including focus group discussions and individual questionnaires as assessment tools. The governorates were selected on the basis of occurrence of HAPI and their involvement in other poultry improvement programmers supported by FAO. The villages were selected by scientists (team

leaders), mainly on the basis of actual backyard poultry ownership and willingness for participation in interviews. The villages that were selected from each governorate were distant from each other in order to cover an area as wide possible. Collecting the data from house holds first required establishing a relationship and exchanging knowledge between the interviewer and the households and families. The main activities included:

- Household interviews according to a pre-defined format. The interviews covered areas such as general characterization of the household, poultry management, feeding and work responsibilities. In total 432 and 108 Interviews were implemented with priority of the farm for chickens and duck, respectively with an equal number in the three governorates.
- Collecting of 324 and 36 blood samples from chicken and ducks. The blood samples were blotted onto filter paper and sent to ILRI[2] Nairobi for molecular analysis (*samples are currently analyzed*).
- Gathering of information from 2,500 individual birds (2,000 chicks and 500 ducks). This involved physical examination of birds for phenotypic characteristics by means of a pre-designed checklist and taking measurements such as weight, shank length and individual bird pictures for characterization purposes.

Field data were collected during the same day in each village. Other information was also collected through informal interviews with key informants, national researchers, and extensionists in selected villages. The SAS analytical software version 9.1 (SAS©) was used to analyze the data.

Results and Discussion

Breed and type characteristics

Results scope of this paper is on two main results; 1) phenotype characterization of both Baladi chickens and ducks, and 2) blood molecular analysis; which is currently conducted on blood samples collected from house holds in all three governorates (*not included in data*).

Both body weights of Baladi chickens and ducks at Al-Gharbya and Sohag governorates were significantly ($P \leq 0.05$) higher than those in Al-Fayoum. In Baladi chicken males, Sohag was significantly lower ($P \leq 0.05$) than Al-Gharbya in body weights 1267.20 *vs.*1118.30 gm, respectively (Table 1). However, Al-Gharbya and Sohag governorates were statistically ($P \geq 0.05$) similar in female Baladi chickens and males and females ducks body weights.

On the other hand, in regard to shank length, among all studied governorates, only Al-Fayoum showed a significantly ($P \leq 0.05$) longer shank (cm.) in both Baladi chickens and ducks followed by Al-Gharbya and finally Sohag with the shortest shanks (Table 2). These finding are surprising as according to house holds from studied governorates, owned Baladi chickens are mostly obtained; from mobile sellers who originally buy these chickens from random commercial farms in both Al-Gharbya and Sohag governorates. However, the case is different in Al-Fayoum, as

[2]Samples are being analyzed at the International livestock research institute (ILRI) Nairobi – Kenya.

most Baladi chickens in almost all Fayoum villages originate from one source; El-Azzab project for improving Baladi local strains. It is right that a portion of individual households still buy their chickens from mobile chick sellers, but the rest buy it directly from Al-Azzab project. May be the case in Sohag is somehow environmentally related as according the findings of Mathur, El-Hammady and Sharara (1989) as they reported an increase in egg production through incorporating naked neck (Na) genes in a crossbreeding program of local Fayoumi. In Sohag, several cases of naked neck chickens were found in a larger percent as compared to the other two governorates. Similarly, Horst and Mathur (1992) reported favorable effects of naked neck (Na) and frizzle (F) genes on egg production and egg weight and of the dwarf gene (dw) on feed efficiency of chickens under heat stress.

Sohag governorate, had the highest percent of white skin color of Baladi chickens followed by Al-Gharbya (Table 3). However, it is interesting to note that the yellow and black skin colors were also noted in Al-Fayoum chickens. Furthermore, Al-Fayoum had a higher percent of single comb and brown eye colors. These findings in Al-Fayoum are in line with most of house holds feed back that most of Baladi chickens in this governorate originate from Al-Azzab farms. Fayoumi chickens is one component used in strains cross breeding for genetic improving of local Baladi chickens in this project. This is why most of Baladi chickens in this region almost identical in phenotype characters related to Fayoumi in the first place. It is also notable, the in Al-Gharbya, chickens exhibited a multi pattern relating to comb type and eye color covering all different shapes and colors, this might be due to higher not intended cross breeding used by local house holds to mate and hatch their flocks. Asimilar pattern is also notedin Sohag , but with less intensity. Researchers did not find frizzled feather or beard and muffs in birds. However, there was small percent of crest existing in Al-Gharbya governorate, this lead to the same above mentioned conclusion of a larger scale of genetic varieties located in that governorate compared to the other two. Naked neck hens were noted in both Al-Fayoum and Sohag, but none was recorded in Al-Gharbya. The existence of the naked neck gene might play a role in higher environment adaptation would also relate to better performance (Mathur, El-Hammady and Sharara 1989; and Horst and Mathur, 1992).

Al-Fayoum governorate displayed higher incidence of red and red/ white earlobe in chickens tested in that region followed by Sohag governorate (Table 4). Furthermore, Al-Fayoum had also, a higher white, yellow and green/ blue shank color, while, Al-Gharbya showed a wide spectrum of shank colors, which match the trend of most of phenotype characters in this governorate.

Duck's shank color was mainly black especially in Sohag governorate (Table 5). However, yellow and white shank colors were also noted in a fair percentage in both Al-Gharbya and Al-Fayoum. There was no difinate pattern for bill color in all studied three governorates, as black bill was dominating in Al-Gharbya, yellow in Al-Fayoum and pink/ white bill was higher in Sohag. Uniform bill shape was recorded in all governorates, with a slight exception in Al-fayuom where saddle bill was noted in a small percent. White skin color was dominating in both Al-Fayoum and Sohag, while yellow skin color was also recorded in small percent in Al-Gharbya (Table 6). No crest was recorded in Sohag, while was recorded in Al-Gharbya and in a larger percent in Al-Fayoum. Brown eye color was noted in both Al-Gharbya and Sohag,

while yellow eye color existed in lager percent in Al-Fayoum (Table 7). It is also notable that in Al-Gharbya, there was a wide spectrum of eye colors. Red crauncle was dominating in Al-Gharbya and Sohag, while Al-Fayoum showed a smaller percent of black crauncle.

Acknowledgements

Thanks are due to the FAO Emergency Centre for Transboundary Animal Diseases (ECTAD) country team, for their guidance and assistance in implementing of the field work, and training of field teams. Special appreciation goes to governorates teams for their constant dedicated work and support that helped in data collection and interviews.

Table 1. Body weights (in grams) of Baladi chickens and ducks from selected house holds in villages of three governorates								
	Baladi chickens				Ducks			
Governorate	Males		Females		Males		Females	
	No	x ± SD	No	x ± SD	No	x ± SD	No	x ± SD
El-Gharbya	90	1267.20[a] ± 598.40	514	1040.25[a] ±420.08	13	2812.00[a] ± 935.28	21	3199.33[a] ± 593.04
El-Fayoum	65	852.94[c] ± 400.95	537	889.65[b] ± 381.76	20	1711.20[b] ± 517.39	27	1431.63[b] ± 524.80
Sohag	60	1118.30[b] ± 418.90	586	1038.50[a] ± 273.00	9	2600.00[a] ± 313.50	27	1713.60[a] ± 376.60
Total	215	1079.48 ± 524.31	1637	990.20 ± 366.75	42	2242.50 ± 817.30	75	1653.60 ± 518.20
Probabilities		**		**		**		**

Table 2. Shank length (in cm) of Baladi chickens and ducks from selected house holds in villages of three governorates								
	Baladi chickens				Ducks			
Governorate	Males		Females		Males		Females	
	No	x ± SD	No	x ± SD	No	x ± SD	No	x ± SD
El-Gharbya	90	8.54[b] ± 1.37	514	7.41[b] ± 0.91	13	6.37[b] ± 1.21	21	6.15[b] ± 0.98
El-Fayoum	65	9.25[a] ± 1.37	533	8.63[a] ± 0.90	20	7.27[a] ± 0.69	26	7.12[a] ± 0.87
Sohag	60	7.85[c] ± 1.15	586	6.52[c] ± 0.70	9	5.67[c] ± 0.71	27	4.70[c] ± 0.86
Total	215	8.56 ± 1.41	1633	7.50± 1.21	42	6.60 ± 1.00	74	6.01± 1.33
Probabilities		**		**		*		**

Table 3. Skin color, comb type and eye colors of Baladi chickens from selected house holds in villages of three governorates

Governorate	Baladi chickens															
	Skin color (%)				Comb type (%)						Eye color (%)					
	No	W	Y	B	No	S	P	R	C	D	No	O	B	R	P	G
El-Gharbya	655	98.20	1.80	--	661	77.46	18.61	0.20	0.60	3.17	665	75.64	5.11	6.3	12.93	--
El-Fayoum	597	93.63	3.69	2.68	607	99.34	0.66	--	--	--	594	56.91	40.74	0.61	1.68	--
Sohag	646	99.69	0.31	--	646	97.99	0.15	--	--	1.86	646	88.39	16.69	--	0.46	0.46
Total	1898	97.17	1.94	0.89	1914	91.60	6.47	0.07	0.20	1.68	1905	73.65	18.85	2.3	5.06	0.15

No: number of samples
W: white Y: yellow
B: black

No: number of samples
S: single P: pea
R: rose C: Cushion D: double

No: number of samples
O: orange B: brown
R: red P: pearl G: green

Table 4. Earlobe and Shank color of Baladi chickens of house holds in selected villages in three governorates

Governorate	Baladi chickens										
	Earlobe color					Shank color					
	No	R	W	B	RW	No	W	GB	B	Y	G
El-Gharbya	658	64.74	28.26	--	6.99	654	41.00	8.00	0.76	40.00	10.09
El-Fayoum	609	71.57	5.29	0.83	22.31	599	46.91	25.21	1.17	26.71	--
Sohag	646	24.93	34.98	--	40.09	646	43.03	19.50	4.33	31.58	1.55
Total	1913	53.75	22.84	0.28	23.13	1899	43.65	17.57	2.09	32.76	3.88

No: number of samples
R: red W: white B: blue RW: red/white

N: number of samples
W: white GB: gray/ blue B: blue Y: yellow G: green

Table 5. Shank and bill color, and bill shape in ducks of house holds in selected villages in three governorates

Governorate	Ducks															
	Shank color						Bill color							Bill shape		
	N	Y	G	GB	B	W	N[1]	PW	Y	O	SG	G	B	N	U	S
El-Gharbya	36	8.33	--	8.33	41.67	41.67	36	38.88	11.10	5.56	--	--	44.4	36	100.00	--
El-Fayoum	45	35.55	--	--	37.78	26.67	43	16.28	41.86	--	2.33	6.96	32.55	47	88.89	11.11
Sohag	36	33.33	2.78	--	61.11	2.78	36	41.67	11.11	--	--	--	47.22	36	100.00	--
Total	117	25.74	0.93	2.78	46.85	23.71	115	32.28	21.36	1.85	0.78	2.32	41.39	119	96.30	3.70

[1]N: number of samples
Y: yellow G: gray GB: gray/ black
B:black W: white

N: number of samples
PW: pink/ white Y: yellow O: orange
SG: slate/ gray G: green B: black

N: number of samples
U: uniform
S: saddle

Table 6. Skin color and crest percentage in ducks of house holds in selected villages in three governorates

Governorate	Ducks					
	Skin color			crest		
	N[1]	W	Y	N	Yes	No
El-Gharbya	36	94.44	5.55	36	2.77	97.22
El-Fayoum	45	100.00	--	47	14.89	85.11
Sohag	36	100.00	--	36	--	100.00
Total	117	98.15	1.85	119	5.89	94

[1]N: number of samples
W: white Y: yellow

Table 7. Eye and caruncles color in ducks of house holds in selected villages in three governorates

Governorate	Ducks									
	Eye color						Caruncle color			
	N[1]	Y	BR	GB	BL	B	N	R	B	RB
El-Gharbya	36	8.30	77.70	2.77	5.55	5.55	29	100.00	--	--
El-Fayoum	37	48.65	40.59	--	--	10.81	19	84.21	15.79	--
Sohag	36	5.56	69.44	8.33	16.67	--	31	100.00	--	--
Total	109	20.50	62.58	3.70	7.41	5.45	79	94.74	5.26	--

[1]N: number of samples
Y: yellow BR: brown
GB: gray/ brown BL: blue B: black

N: number of samples
R:red B: blue
RB: red/ black

References

FAO (2000). *World Watch List – for domestic animal diversity. 3rd edition. FAO, Rome.*

Fulton, J. E. (2006). *Avian Genetic Stock Preservation: An Industry Perspective. Poultry Science 85(2):227–231*

Fulton, J. E., and M. E. Delany. (2003). *Poultry genetic resources— Operation rescue needed. Science 300:1667–1668.*

Goodland, R. (1995). *The concept of environmental sustainability. Annual Review of Ecological Systems 26:1–24.*

Hodges, J. (2006). *Conservation of Genes and Culture: Historical and Contemporary Issues. Poultry Science 85(2):200–209.*

Horst, P. and Mathur, P. K. (1992). *Trends in economic values of selection traits for local egg production. Proceedings, 19th World Poultry Congress, Amsterdam, the Netherlands, 20–24 September 1992, Vol. 2, p. 577–583.*

Mathur, P. K., EI-Hammady, H. and Sharara, H, (1989). *Specific use of high yielding strains carrying major genes for improving performance of local Fowl of tropics (case study: Uer, Egypt). Presented at the 4th DLG Symposium on Poultry Production in Hot Climates, 18–21 June, Hameln, Germany.*

SAS, (2003). *Statistical Analysis System User's Guide: Statistics. SAS Institute Inc., Cary, NC.*

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. Proceedings of the 5th Vietnamese-Hungarian International Conference on „Animal Production and Aquaculture for Sustainable Farming" Can Tho University, Can Tho, Vietnam, 11-15 August, 2007*

Tixier-Boichard, M., W. Ayalew & H. Jianlin (2008). *Inventory, characterization and monitoring. Animal Genetic Resources Information (AGRI), 42: 29-47*

Pisenti, J. M., M. E. Delany, R. L. Taylor, Jr., U. K. Abbott, H. Abplanalp, J. A. Arthur, M. R. Bakst, C. Baxter-Jones, J. J. Bitgood, F. Bradley, K. M. Cheng, R. R. Dietert, J. B. Dodgson, A. Donoghue, A. E. Emsley, R. Etches, R. R. Frahm, R. J. Gerrits, P. F. Goetinck, A. A. Grunder, D. E. Harry, S. J. Lamont, G. R. Martin, P. E. McGuire, G. P. Moberg, L. J. Pierro, C. O. Qualset, M. Qureshi, F. Schultz, and B. W. Wilson. (1999). *Avian genetic*

resources at risk: An assessment and proposal for conservation of genetic stocks in the USA and Canada. Rep. No. 20. Univ. California Division of Agriculture and Natural Resources, Genetic Resources Conservation Program, Davis, CA. http://www.grcp.ucdavis.edu/publications/doc20/full.pdf

Weigend S., M. N. Romanov, and D. Rath (2004). *Methodologies to identify evaluate and conserve poultry genetic resources.* http://www.fao.org/Ag/AGAInfo/themes/en/infpd/documents/papers/2004/methodoligies297.pdf

Woelders H., C. A. Zuidberg, and S. J. Hiemstra (2006). *Animal Genetic Resources Conservation in the Netherlands and Europe: poultry perspective. Poultry Science 85(2):216–222.*