Hemoglobin polymorphism in different animal species in Iraq

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Abstract

This study was conducted for studying hemoglobin types in farm animals (cattle, sheep and poultry) in central part of Iraq. The results revealed that the fixation of hemoglobin type A in Friesian cattle which was born and raised in Baghdad. While in sheep; hemoglobin type B was dominant in the three major native breeds of sheep (Awassi, Arrabi and Karradi), the Genotypes frequencies of hemoglobin type B were 0.96, 0.98 and 0.95 respectively. In white leghorn which was raised in middle part of Iraq and in compared with the native breed showed both types of hemoglobin (A and B) in different frequencies.

تنوع الصفات المظهرية لنوعية الهيموغلوبين بين مختلف حيوانات المزرعة في العراق

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الخلاصة

أجريت هذه الدراسة لمعرفة نوعية هيموغلوبين الدم في حيوانات المزرعة (أبقار وأغنام ودواجن) في المنطقة الوسطى من العراق. بينت النتائج ثبوت نوع هيموغلوبين A في الأبقار الفريزيان المولودة والمرباة في وسط العراق. أما في الأغنام فكانت صفة هيموغلوبين الدم نوع B هي السائدة في السلالات الثلاثة الرئيسية في العراق (العواسي والعرابي والكرادي)، حيث كانت نسبة التكرار الجيني لصفة الهيموغلوبين نوع B 0.96 و0.98 و0.95 في السلالات الثلاث وعلى التوالي. أما دجاج الليكهورن الأبيض والذي تم تربيته في بغداد فقد اظهر نسب متفاوتة لصفتي هيموغلوبين A وB،ومتباينة عما أظهره الدجاج المحلي في وسط العراق.

Introduction

Many workers have identified the existence of three major Hb-types (AA,AB,BB) caused by Hb-A and B genes in cattle, sheep and chickens, though some rare Hb-types were also reported; of these studies (1,2,3,4,5) in cattle, (6,7,8,9,10,11,12) in sheep. And (13,14,15,16,17,18) in chickens. Those studies indicated differences in gene and genotype frequencies for geographical and climatic regions; some explanations were given for such variation.

Materials and Methods

This study was conducted in Iraq to examine gene and genotype frequencies of Hb-types in Iraqi farm animals. Results related to Hb-type frequencies were extracted and used in this study.

Sheep included Two studies (a_1) and (a_2), cattle (b) and chicken (c).

(a_1)Two samples of local Awassi, a mildly selected flock for fertility and body weight raised in Baghdad and a random breed group brought for slaughter in Baghdad abattoir from different localities of central Iraq (round Baghdad).

(a_2)Three samples of local breeds lived in middle, south and north of Iraq and those breeds were Awassi, Arrabi and Karradi respectively.

(b) -Cattle included two breeds, the Iraqi born Friesians, their dams imported from temperate climates, mostly from Holland, France and Germany, and raised in Baghdad area where mean atmospheric temperature ranges between 4-46^{o} C in Winter (January) and Summer (July) respectively; and the Sharabi local breed, living in Mousul, Northern Iraq with a range of between 2.4-43 ^{o}C for January and July respectively.

(c) -Chickens were of two strains, a native Iraqi and white leghorn, both were raised in Baghdad. The white-leghorn was raised in the same station for at least (10) generations with a breeding population of not less than (1000) at any generations. The native Iraqi has the same structure, breeding population and raised in the same station. Both the Native and the white leghorn are of the light type.

Results

Results, on gene and genotype frequencies for cattle, sheep and chickens were given in Table (1).

The data reflected that Friesian cattle, born in Iraq and raised in Baghdad (center of Iraq) were fixed for Hb-A while both alleles, A and B are still segregating in the population of native Sharabi cattle in Mousul, north of Iraq, with frequencies of 0.65 and 0.35 respectively. The three genotypes were present with frequencies of 0.47, 0.36 and 0.17 for AA, AB and BB respectively.

The selected ewes, rams and lambs, which are raised in Baghdad are nearly fixed for Hb-B with a gene frequency of 0.98; Hb-A is very rare in ewes and lambs, while rams are fixed for Hb-B. In the other hand the gene frequencies of the local breeds Awassi, Arrabi and Karradi were 0.98, 0.99 and 0.97 respectively.

Genotype frequencies in ewe and lambs were 0.96, 0.97 and 0.04, 0.03 for BB and AB respectively, and in the local breeds the frequencies were; Awassi 0.96, Arrabi 0.98 and Karradi 0.95.

The white-leghorn which were raised in Iraq (Baghdad) for at least (10) generation, and the Native Iraqi chicken showed both A and B alleles at a frequency of 0.65 and 0.35 for leghorn and 0.54 and 0.46 for native Iraqi respectively. The three genotypes were present (Table 1).

Table(1) Gene and genotype frequencies of Hb-types in cattle, sheep and chicken

Species		Genotype frequency			Gene frequency	
		AA	AB	BB	A	B
Cattle	Friesins (Born in Baghdad)	1.00	-	-	1.00	-
	Sharabi (Mousul)	0.47	0.36	0.17	0.65	0.35
Sheep	Ewes	-	0.04	0.96	0.02	0.98
	Lambs	-	0.03	0.97	0.015	0.0985
	Rams	-	-	1.00	-	1.00
	Random breed	-	0.04	0.96	0.02	0.98
	Awassi (local breed)	-	0.04	0.96	0.02	0.98
	Arrabi (local breed)	-	0.02	0.98	0.01	0.99
	Karradi (local breed)	-	0.05	0.95	0.025	0.97
Chicken	White-leghorn	0.562	0.175	0.263	0.65	0.35
	Native Iraqi	0.375	0.337	0.288	0.54	0.457

Discussion

Most of the studies on different species and breeds revealed the existence of blood biochemical differences (including Hb-type). Nevertheless, the mechanism of such polymorphism is not clear or constant.

Evans, et al (6), in a extensive survey of more than 30 different British breeds of sheep showed the majority of these breeds are polymorphic to the Hb-gene with large differences in frequency. The mountain and hill breeds, particularly of the Northern part of British, tend to have higher Hb-A, while the low land breeds tend to have Hb-AB and Hb-B. Pieragostini et al. (19) found that the Hb^A is more frequent in sheep living in areas above 40^o C latitude.

An evidence on cattle was presented by Sengupta (20). Hb-B found to be favored in hot arid climate and Hb-B appeared to be less frequent in hot arid climate than in warm

humid. Sun et al. (21) in their studies suggested that different oxygen (Hb-B). They also found that sheep with Hb-B were not able to withstand the stress of acute hypoxia compared to sheep with Hb-A. Al-Murrani and Timimi (2), found (for Sharabi cattle) that the rank of respiration rates was BB, AB than AA as the lowest though differences were not significant. Body temperature was significantly higher in BB type followed by AA and AB ($p<0.05$). Coefficient of heat tolerance was significantly higher in AB ($p<0.05$) followed by AA, BB types. There was no significant association between Hb-type and milk production.

Al-Murrani and Al-Samarrae (22), found that Awassi native breed of sheep is nearly fixed for Hb-B with a frequency of (0.98) in the selected group of sheep studied. The random breed Awassi group which was collected from different geographical localities has the same high B frequency of (0.98). This means that long term selection in Awassi, though mild, for fertility and body weight is not correlated with Hb-type. In the above mentioned study no association was found between Hb-type and fertility and\ or mortality; the only significant association was found between Hb-B and HK (high potassium) genotype and high lambing percentage.

Al-Murrani, et al. (14) noticed no significant relation between Hb-type and some measures of resistance to coccidiosis in chicken, both in the Iraqi Native and the white-leghorn. Nihat et al. (23), in their study showed that the ewes with Hb-type AB gave better lambs in their birth weight ($p<0.05$). Al-Samarrae, (10), studied the differences in genotype and gene frequencies of Hb-type between the most important three breeds of sheep in Iraq (Awassi, Arrabi and Karrad), and the result showed no important differences.

If the above or any other results and explanations within breed and species in different environmental hold as an expected results to the effect of natural selection, the differences between breeds and species in the same environment, found in this study, Table (1), pauses an unexplainable observation that merits further studies. If Hb-type is connected or have any adaptive significance, it should not be different breeds and species living in the same geographical and climatic region, especially that Hb-physiology and role is the same is all animals.

The present diversity of gene and genotype frequencies might be due to random genetic drift or to some kind of unrevealed association with fitness that worth a deeper investigation. On light of such results it seems reasonable to suggest that genetic markers which are not closely connected with fitness offer no chance for use in correlated selection programs.

References

1. Bangham, A. D. (1957). Distribution of electrophoretically different hemoglobin among breeds of Great Britain Nature, London, 179:467-468.
2. Al-Murrani, W. K. & Al-Timimi, Y. (1990). The inheritance of Hb and Tf-types and its relation with some production and adaptive traits in cattle, Proc. Of the 4th world cong. On genetics applied to livestock production. Edinburgh. UK.
3. Sirats'kyi, I. Z. & Fedorovych, Lei. (2002). Genetic polymorphism of blood and milk enzymes. Tsitol Genet., 36(2):53-9.
4. Ibeagha-Awemu, E. M.; Jager, S. & Erhardi, G. (2004). Polymorphism in blood protein of of cattle breed of Cameron. Biochem. Genet., 42(5-6):181-97.
5. Nedjar-Arroume, N.; Dubbois-Deival, V.; Adje, Y. E.; Traisnel, J.; Krier, F.; Mary, P.; Kouach, M.; Briand, G. & Guillochon, D. (2008). Bovine hemoglobin: an attractive source of antibacterial peptides. Peptides., 29(6):969-77.

6. Evans, J. V.; Harris, H. & Warren, F. L. (1958). Hemoglobin and potassium blood types in some non-British breeds of sheep in certain rare breeds. Nature,182:320-321.
7. Missohou, A.; Nguyen, T. C.; Sow, R. & Gueye, A. (1999). Blood polymorphism in West African breeds of sheep. Trop anim. Health Prod., 31(3):175-9.
8. Miresan, V. (2003). Evolution of the main blood indices in Tisigai fattening sheep. J. central European Agric., Vol.4.
9. Mohri, M.; Jannatabadi, A. A. & Aslani, M. R. (2005). Studies on haemoglobin polymorphism of two breeds of Iranian sheep and its relationship to concentrations of iron, copper, haemoglobin, haematocrit and RBC number. Vet. Res. Commun., 29 (4):305-12.
10. Al-Samarrae, S. H. (2006). Potentiality employment of some hematological and biochemical criterions for evaluation of productivity performance traits of Iraqi sheep. Ph.D. Thesis, University of Baghdad.
11. McManus, C.; Paludo, G. R.; Louvandini, H.; Gugel, R.; Sasaki, L. C. & Paiva, S.R. (2009). Heat tolerance in Brazilian sheep: physiological and blood parameter. Trop. Anim. Health Prod., 41(1):95-101.
12. Tsunoda, K.; Chang, H.; Chang, G.; Sun, W.; Dorji, T.; Tshering, G.; Yamamoto, Y. & Namikawa, T. (2010). Phylogeny of local breeds in East Asia. Biochem. Gent., 48(1-2):1-12.
13. Rodnan, G. P. & Ebugh, F. G. (1957). Paper electrophoresis of animal hemoglobin. Proc. Soc. Exp. Biol. And Med. 95:397 cited by Sturkei, (1965).
14. Al-Murrani, W. K.; Al-Dulaimi, S. & Al-Attar, M. (1996). Resistance of local and white-leghorn chickens to *Eimeria tenella* infection. IPA J. of Agric.Res., 6(1).
15. Gou, X.; Li, N. & Wu, C. (2005). Hypoxia adaptation and hemoglobin mutation in Tibetan chick embryo. Sci. China Life Sci., 48(6):616-23.
16. Jiang, C.; Wang, X.; Gago, W.; Peng, W. Y.; Xie, J. X. & Li, Y.J. (2008). Kinetic of hemoglobin carrying and releasing oxygen. Sheng Li Xue Bao.
17. Minka, N. S. & Ayo, J.O. (2008). Haematology and behavior of pullets transporting by road and administered with ascorbic acid during the hot dry season. Res. Vet. Sci., 85(2)389-93.
18. McCracken, K. G.; Barger, C. P. & Wilson, R. E. (2009). Signatures of high-altitude adaptation in the major hemoglobin of five species of Andean dabbling ducks. Am. Nat.,174(5):631-50.
19. Pieragostini, E.; Rubino, G. & Caroli, A. (2006). Functional effect of hemoglobin polymorphism on the hemoglobin pattern of gentile di Puglia sheep. J. Anim. Breed Genet.,123(2)122-30.
20. Sengupta, B. P. (1976). Hemoglobin polymorphism and its possible adaptive significance in Zebu cattle. Indian J. Anim. Sci., 46(2):72-76.
21. Sun, W.; Chang, H.; Yang, Z.; Geng, R. & Hussein, M. H. (2007). Analysis on origin and phylogenetic status of Tong sheep using 12 blood protein and nonprotein markers. J. Genet. Genomics., 34(12):1097-105.
22. Al-Murrani, W. K. & Al-Samaarrae, S. H. (1982). Association between potassium and Hb-type with production and reproduction in Iraqi Awassi sheep. Proc. World congress on sheep and beef cattle breeding, Vol. 1.
23. Nihat, M.; Handen, G. & Velat, A. (2003). Correlation between biochemical parameters and production Traits in Merino crosses sheep. Haemoglobin and Transferrin types. Turk. J. Vet. Anim. Sci., 27:575-581.