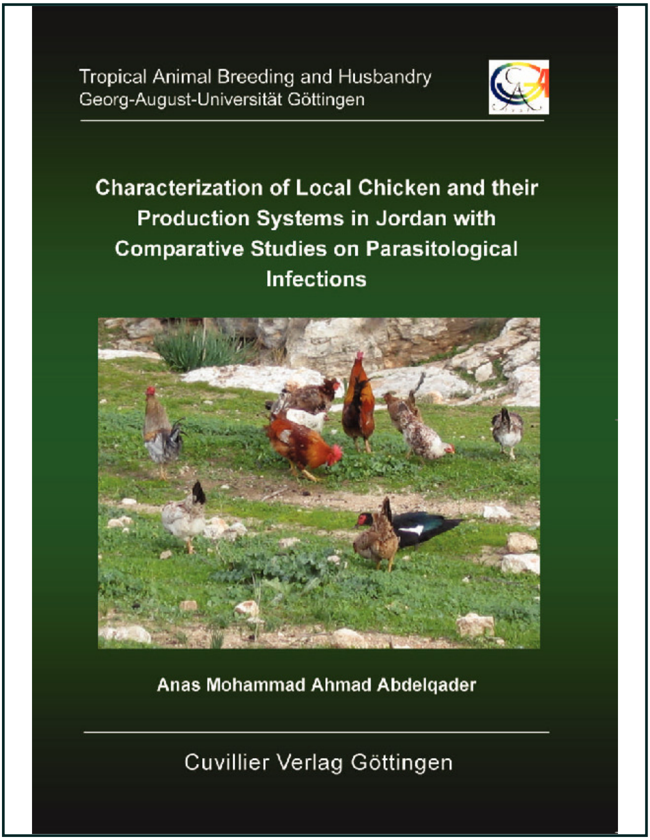
Anas Abdelqader (Autor)

Characterization of Local Chicken and their Production Systems in Jordan with Comparative Studies on Parasitological Infections



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SUMMARY

The main objectives of the current study were to characterize the local chicken (LC) and their production systems in Jordan, to investigate the prevalence of different gastrointestinal helminthes in these systems and to compare the resistance response of LC and Lohmann White (LW) when challenged by different geographic sources of parasites. The study aimed to accomplish four approaches. First approach, the phenotype diversity in local chickens' populations has been investigated for sustainable utilization of local genetic resources. Second approach was to provide base-line data about the production potential of LC and to study the improvement opportunities in order to be implemented for further planning and development of this sector. The third was to determine the helminthes infection rate and species prevalence in LC production systems to establish control strategies. The fourth approach compares the genetic potential of local chicken as adaptive traits to resist internal parasite infection and the opportunity to utilize adaptive traits in future breeding programs.

The study was carried out in the rural areas of northern districts of Jordan. The area is of Mediterranean climate with annual precipitation about 200 - 350 mm. On-farm studies and surveys were carried out in 18 villages with participation of 120 households. The study was accomplished in two phases, the first was conducted from October 2004 to February 2005 and the second was conducted from May to July 2005.

On-farm surveys were conducted to investigate biodiversity of LC and their performance potential. A sample of 846 adult LC was phenotypically characterized based on morphology, feather colors, comb shape, and performance. The prevalence of other poultry species was also investigated and chickens were the most prevalent species (92.4 % of poultry population). Other poultry species were mainly Pigeons, Guinea fowl and Turkey. The results indicated three main chickens' types and many variants of chickens' phenotypes. The level of morphological and phenotypic heterogeneity was high. The most predominant chicken type was Baladi chicken (67.3 %) followed by Pakistani (27.7 %) and Brahma (5 %). Naked neck and Frizzled phenotype were occasionally observed in the study area. The Baladi type was characterized by its small size compared to Pakistani and Brahma. It has horizontal body position and large vertical tail. Pakistani type characterized by the upright stance, larger body size than Baladi, the tail slope to be horizontal rather than vertical, soft and long feather, prominent shoulders and narrow stern. Braham has a very large body size, heavy bone and muscles. They are highly feathered birds with heavily feathered legs and toes.

Many plumage colors were observed in LC populations. Individual chicken might have single, two or many colors (mottled). The mottled was the most predominant (23.1 %) followed by the black (19.5 %) and light brownish color (19.1 %). Brown and black was relatively prevalent (17.0 %). Other variants like spotted, grey, red, spangled green, and yellow were seen in different proportions. Many comb variants were found, the single comb type was the most predominant (80.3 %). Other variants were Buttercup shape, Double, Pea shape and V-shaped with feather cap.

In some LC flocks, exotic strains were free-roaming together with LC. Crossbreeding occurred accidentally. Based on phenotypic assessment, quantitative estimates of the substitution of local genetic material due to uncontrolled crossbreeding were difficult. The local genetic resources are threatened by indiscriminate crossbreeding. There is need to preserve genetic diversity of the local chicken in Jordan.

In the second approach, on-farm surveys supported with a structured questionnaire were conducted to characterize the productive and reproductive performance of LC and to describe their production systems under different levels of management. Data were collected through direct observation, direct measurements and individual farmers' interviews. Data of marketing were collected from farmers during the survey and regular visits to the market. Data of flock structure and breeding were achieved by census of flock size and structure in the study area. A scoring system was developed to study the effect of different levels of management on chicken performance. Levels of management scores (MS) were assigned as very poor (MS=1), poor (MS=2), good (MS=3), and very good (MS=4). Data of hatchability and rate of chicks' survivability were gathered by monitoring study. A group of farmers (n=52) were requested to record number of eggs incubated, chicks hatched, died or lost and causes of loss in the flocks.

Local chickens play many functions in the livelihood of rural families. Most of the households (94.2%) kept chicken for nutritional and economic functions i.e. consumption of eggs by the family and selling the surplus. The local chicken production system in Jordan is small scale free-range, where birds were confined only during the night. During the daytime birds were roaming the free-range environment closely to the house of the farmer. The main features were the improper housing systems and inadequate scavenging feed resources. Birds were scavenging the households' leftovers like bread and vegetables, insects, worms, harvest leftovers, grass, and grains. Most of the farmers (90.8 %) provide their chickens with supplement feedstuffs, which were mostly barley, cracked wheat and wheat by-product. Mortality rate was high (41.6% at 6 months) in LC flocks, which considered as the major constraint of the production system. The major causes of losses, as ranked by farmers in order of importance, were diseases, parasites, predators and accidents. About 51 % of farmers reported Newcastle disease (NCD) as the most prevalent disease. Few households (12%) applied vaccines against NCD and Infectious Bronchitis (IB). The main predators were foxes and wild cats. Young chicks were threatened mainly by cats and rodents. Local chicken marketing system was simple and direct. This might be merely due to the few numbers of chickens sold per household. Local chicken and eggs were sold mainly in the village, where farmers sold chicken, chicks, and egg to inhabitants of the same village or other neighboring villages. Another marketing channel was through the Friday market (the only market in the study area where farmers were able to sell and buy local poultry). Farmers, middlemen, and boys bring chicken and eggs to the market for selling or to exchange with other poultry species. Chicken pricing was depending on the chicken phenotype, sex, age, and season of year. Brahma had the highest marketing value, followed by Pakistani and the least was the Baladi chicken. Brahma chicken was highly attracting the hobbyists, while Pakistani chickens found to have higher potential for egg production than Baladi. Female had higher selling value than male. Grower birds (1-5 months) had lower price value than mature birds (6-18 months). Older birds (> 2 years) were the least in price scale except for Brahma which had a stable price. During summer season local chicken had higher prices than during winter.

The general local chicken performance could be summarized as follow: the average flock size was 41.6 (Median 33) chickens per household, with 6.4:1 hen to cock ratio. Hen of LC reached the sexual maturity at about 22-30 weeks of age. The average clutches number was 1-5 per year, with 18-30 eggs per clutch. Hen laid on average 68.9 (range 18 - 130) eggs per year. Body size averaged 1240 ±10 g for adult female and 1890 ±30 g for adult male. Egg weight was 47.9 ±0.66 g on average. Chicken performance was positively ($P < 0.05$) correlated with management score. Farmers applied few inputs (such as feed supplements, vaccination, treatments, house cleaning and disinfection and enough housing and nesting

space) have acquired significant ($P < 0.001$) improvement in flocks' performance. There were positive significant correlations ($P <0.001$) between MS and number of clutches (r= 0.55), egg production (r= 0.50), egg weight (r= 0.56) and egg mass (r= 0.56) and negative significant correlations ($P < 0.001$) between MS and sexual maturity (r= -0.45). The lowest positive correlation was detected between MS and birds body weight (r= 0.29). Hatchability and survivability was strongly correlated with improved management score (r= 0.58 and 0.70, respectively). Flocks of MS 1 have significantly lower hatching and surviving rates than flocks from the higher MS. This also can be reflected by the larger flock sizes found in flocks of MS 3 and 4. Total hatchability of LC under free-range conditions was high (89.9 %). However, the chicks' survival rate was low. About 41.3 % of the hatched chicks were lost before 6 months of age.

Farmers were selecting eggs for incubation from the healthy and good performing hens, which reflects on embryos health and development. Egg production was ranked as the first selection criteria (51.7 % of farmers) followed by body conformation (24.1 %), the mothering ability of the hen (13.8%) and the least was the body weight (10.4%). About one-third of the farmers exchanged eggs with neighbors and relatives for breeding purposes, but the rest of farmers (67.5%) preferred to select eggs from their own flocks. Only 2 % of farmers exchanged birds. Breeding hens per flock were 4 – 80 hens and breeding cocks were 1-15. The effective population size was estimated around 15.35 ±10.4. Rates of inbreeding per generation in LC flocks estimated to be more than 5.52 %.

In the third approach, a cross-sectional study was conducted to determine the prevalence of gastrointestinal and tracheal helminthes among local chickens' populations in the study area. The study covered the two major seasons in Jordan; winter and summer. A total of 208 local LC (99 males and 109 females) were collected from eight villages, which were randomly selected from the study area. The age structures were 52 youngs (3-7 months of age) and 152 adults (8-24 months of age). The trachea and gastrointestinal tract of each bird were examined for the presence of helminthes.

One hundred and fifty two birds were helminthes positive (73.1 % of examined sample). The prevalent helminthes ranged from one single worm to multiple worms with different species. The infection rate in the study area was high in general, which indicates that LC in Jordan are suffering from high helminthosis rate. The poor biosecurity might be one of the important

reasons. The high prevalence rate could be subclinical but can cause significant economic loss due to production losses and, in heavy infections, mortality. Three different nematodes species were isolated namely; *Ascaridia galli*, *Heterakis gallinarum* and *Capillaria obsignata*. Eight cestodes species were isolated namely; *Hymenolepis cantaniana*, *Hymenolepis carioca*, *Raillietina tetragona*, *Raillietina echinobothrida*, *Raillietina cesticillus*, *Choanotaenia infundibulum*, *Amoebotaenia cuneata* and *Davainea proglottina*. Trematodes were not found in the study area, this might be due to the absence of lakes and thus the insufficient number of required intermediate hosts. All helminthes species were collected form the gastrointestinal tract, no helminthes were found in the trachea. Most helminthes species identified in the current study were of pathogenic types that can cause enteritis, ulcerations, emaciation and death. Young chickens and weak birds are negatively affected by these helminthes; particularly when the infection rate is high. This is considered to be one of the major constraints in the production system.

The isolated species had the following prevalence (winter season %, summer season %); respectively: *Ascaridia galli* (33.7, 36.5), *Heterakis gallinarum* (31.7, 34.6), *Capillaria obsignata* (1.0, 0.0), *Hymenolepis cantaniana* (10.6, 11.5), *Hymenolepis carioca* (28.8, 30.8), *Raillietina tetragona* (15.4, 21.2), *Raillietina echinobothrida* (15.4, 17.3), *Raillietina cesticillus* (8.7, 6.7), *Choanotaenia infundibulum* (11.5, 25.0), *Amoebotaenia cuneata* (4.8, 3.8) and *Davainea proglottina* (1.9, 1.0). Overall the study periods the most frequent helminthes were the nematode *Ascaridia galli* followed by *Heterakis gallinarum*. The most prevalent cestodes were *Hymenolepis carioca* and *Raillietina tetragona*. The total worm burden was 12.13 worms per chicken during the winter season compared with 9.77 during the summer season. The total worm burden per male and female chickens was 11.32 and 10.61, respectively. Helminthes' prevalence or burdens were not significantly ($P > 0.05$) affected by the climatic season. In contrast, bird's sex has affected the prevalence and burdens of some species. The males harbored significantly ($P < 0.05$) higher numbers of *Ascaridia galli* and *Raillietina cesticillus* and significantly ($P < 0.05$) lower numbers of *Choanotaenia infundibulum* compared with the females. However, the other species did not reveal any significant ($P > 0.05$) correlation between their burdens and the host sex.

The final approach was conducted to investigate the adaptive potential of LC to resist *Ascaridia galli* infection in comparison with Lohmann White (LW) as an exotic line. Another goal of the study was to investigate the host-parasite co-evolutionary interaction through infection with *Ascaridia galli* from two geographical regions. The assumptions were that different chicken genotypes differ in their susceptibility to *A. galli* and different isolates of *A. galli* differ in their infectious ability. Chicks of LC were obtained by incubating and hatching of eggs collected from local chickens flocks (n = 6 flocks) in northern Jordan. The flocks were scavenging in the free-range together; therefore they were representing one breeding population. LW is a white-egg layer chicken. It is a commercial hybrid line developed by Lohmann Tierzucht GmbH in Germany. The birds were kept under the routine management practice and optimum hygienic environment until slaughter at the end of the experiment.

The study was achieved in two trials. In trial I, 50 birds of LC and 50 birds of LW were infected with German isolates of *A. galli*. In trial II, 45 birds of LC and 45 birds of LW were infected with Jordan isolates of *A. galli*. Twenty birds of LC and 20 birds of LW were kept as uninfected controls. Birds were infected orally at one day old with 250 embryonated *A. galli* eggs per bird. During the study period, seven infected birds from LC and four infected birds from LW died. The experiment ended three days after the first detection of *A. galli* eggs, which was commenced after seven weeks of infection. In both trials weight gain of infected LC was not significantly ($P > 0.05$) different from weight gain of infected LW. In trial I, infected birds of LC showed 5.9 % lower weight gain compared to their control group, while LW showed 3.7 % lower weight gain than their control group. In trial II, weight gain of infected groups was 4.1 % and 1.9 % lower compared to their controls of LC and LW, respectively. No significant ($P > 0.05$) differences were observed in weight gain between the infected and control groups in both trials. The results illustrated significant genetic variation between LC and LW for resistance to *A. galli*. In trial I, the total worm burden was 12.5 ±5.8 worms per bird in LC compared with 19.9 ±4.3 in LW. In trial II total worm burden was 6.20 ±4.7 in LC and 8.45 ±3.7 in LW. Furthermore, LC birds excreted less *A. galli* eggs compared with LW. In the same manner, female worms in LC birds were significantly ($P < 0.05$) less fecund than the female worms in LW.

Results showed that there was a significant ($P < 0.05$) variation in the infection ability of German and Jordan *A. galli*. The mean values of resistance parameters were reduced in trial II compared to trial I. Jordan *A. galli* exhibited significantly ($P < 0.05$) less worm burden, establishment rate, fecal egg count (FEC), and fecundity than German *A. galli*. This reduction indicated that *A. galli* isolated from naturally infected LC in Jordan appear to be less infectious than *A. galli* from Germany for both strains of birds. This evidence supports the effect of genetic background on host-parasite co-evolutionary associations. Results suggest that the variation in genetic background between LC and LW is involved in the resistance to *A. galli* infection. The adaptive values of LC should be appraised. *A. galli* isolates from different geographic areas differ in their ability to infect different chicken genotypes. This should be considered when establishing breeding programs.