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Effect of intensive system with balanced feeding on production, biochemical and immunity index on Andamani duck rearing under various thermal indices

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Abstract

A study was conducted to evaluate the impact of intensive system of rearing with balanced feeding on production, biochemical and immunity index of Andamani duck under various thermal indexes. Andamani ducks were managed under intensive farming system. Datas were collected from micro and macro climatic temperature, relative humidity, production, sero stress and immune biomarkers under both intensive and free range condition. Thermal Humidity Index ranging from 77% to 80% with the environment of intensive system causes moderate discomfort but better than free range system. under intensive management, significantly higher adult body weight, egg weight and egg mass were reported; the evaluation of sero enzymatic activities such as AST, ALT and ALP reported the healthy nature of liver; the sero stress biomarkers such as cortisol and HSP 70 were found significantly lower and the sero cytokine biomarkers viz., IFNγ and MHC were significantly higher in Andamani ducks. It is concluded that Andamani ducks can be very well adapted under intensive system of rearing which is highly suitable for their well-being.

Key words: *Andamani duck; intensive rearing; production; stress and immune biomarkers*

Introduction

The total population of chicken and duck in A&N Islands is 12,83,746 nos. in 2019 (Directorate of economics and statistics, A&N Islands). Next to chicken, the most preferred poultry in Andaman is Andamani duck, the registered native duck of Animal Genetic Resources (AnGR) in A & N Islands. Farmers in Andamans are raising Andamani ducks on free range system. This simple system requires minimal capital investment (Meulen and Dikken, 2004). This native duck rearing is always traditionally integrated as rice–duck farming/ rice-duck-fish farming so also reported in other countries (Zhang *et al.,* 2009). The Andamani duck is a source of animal protein and subsidiary income for rural farmers. This is a very good dual-purpose native duck, has been maintained for many years by farmers and is protected in these remote islands to which they got adapted. However, they are reared under traditional system that has inherent traits of low productivity and they depend on seasonal availability of feed (Salendu, 2012). Hence, the growth and egg production under the extensive system are not fulfilling the demand of resource poor farmers as reported by Etuk *et al.* (2006) while ducks maintained in intensive are giving promising results. Andamani ducks reared under conventional system although has better productivity as compared to other native ducks of the country; they spend more energy to produce egg and meat. Further, feed supplements are hardly given that causes nutrition deficiency.

Day by day, Andamani duck meat is becoming popular as chicken alone could not meet out the requirements. Hence, there is a lot of scope for entrepreneurship opportunity in Andamani duck farming on commercial basis. Scientific management is very much essential to explore Andamani duck as a commercial duck breed. There should be transition in the housing and feeding of present extensive system of management. Intensive rearing is the next alternative management system that can improve the production performance of Andamani duck to make this venture into viable and economical commercial duck farming. Precisely, farmers are declining to adopt intensive systems because of its high cost involvement. However, with encouraging technical guidance, it is quite possible for the farmers to switch over to intensive rearing. The system of rearing is a potential nongenetic cause that has significant role in production and health of duck farming (Liu *et al.,* 2011; Jin *et al.,* 2019; Wan *et al.,* 2021; Guo *et al.,* 2021; Abo Ghanima *et al.,* 2020). Intensive system of

rearing ie., floor rearing system is environment friendly and animal welfare-promoting system that improves duck comfort and its performance as well (Wang *et al.,* 2023). Keeping this in account, a study was undertaken with the objective of evaluating intensive system of rearing with balanced feeding on production, biochemical and immunity index on Andamani duck under various thermal indexes.

Materials and Methods

The present work was done at organized farm, South Andaman. One hundred numbers of Andamani duck growers of 12 weeks old were collected from the field, weighed individually and were provided with duck grower mash under intensive farming system. The system provided space requirement @ 4.0 sqft per adult duck and cemented floor was covered with wood shaving upto 10 cm thick as per (Wang *et al.,* 2015; De Almeida *et al.,* 2017) to absorb feacal materials. *Ad-libitum* feed and tailor made continuous water resource was provided. The pond facility was arranged outside the shed to support their swimming natural habit of the ducks. Ducks were freely allowed around the shed for 6 hours a day. They were using pond to exercise their natural habit of swimming.

Data collection

Production performance

The average feed consumption, body weight at the age of pullet growers, sexual maturity and laying period were recorded. Hen housed egg production and egg weight were recorded.

Around 3-4 ml of blood was collected at monthly interval in activator vacutainers and allowed to stand at room temperature for 30 minutes. The vacutainers were then centrifuged at 2000 × g for 15 minutes and the collected serum samples were stored at -20°C until further analysis. The serum biochemical parameters viz., Protein (g/dl), Cholesterol (mg/dl), Alkaline phosphatase (U/L), Creatinine, mg/dl), Aspartate amino transferase (U/L) and Alanine transaminase (U/L) were quantified in the UV spectrophotometer using AGAPPE kits (commercial grades) and ELISA kits were used to quantify stress parameters such as cortisol (ng/dl) and heat shock protein (HSP 70) ((ng/ml)) and parameters responsible for immunity such Major Histo Compatibility (MHC) and Interferron gamma (INFγ pg/ml)).

The above data were collected from Andamani duck (N = 70) under free range condition for comparison where in, the ducks were traditionally reared getting access to field to search for feed with rice or wheat supplement by late evening.

Results and Discussion

The overall mean microclimatic temperature, relative humidity percentage and thermal humidity index (THI) under intensive system were 28.93±1.52°C, 81.55 ± 5.63% and 80.10 ± 1.15 respectively. The seasonal Relative humidity fluctuated highly from 78% to 87%. Similar parameters at macro climatic condition ie., free range system was 29.10 ± 1.45°C, 78.2 ± 3.82% and 81.50 ± 1.08. As given in the Fig 1. the temperature and Thermal Humidity Index fluctuated from Jan to June; however, they were found to be stable from July to December. THI under intensive system was significantly lower by one unit as compared to extensive system. The thermal comfort zone for poultry beyond 21 days of age is ranging from 15ºC to 26ºC for temperature and 50% to 70% (Medeiros, 2001; Fabricio, 1994 and Timmons and Gates, 1988) for relative humidity (RH). Many factors such as genetics, sex, age, nutrition, production and adaptation affect the comfort zone. With Thermal Humidity Index from 77% to 80%, the present environment of intensive system causes moderate discomfort (Moraes *et al.,* 2025). However, the shed and swimming facility provided to the ducks made them to be comfortable during rainy and sunny days.

The body weight of Andamani ducks under intensive system was significantly higher at pullet grower stage by 47 per cent, age at sexual maturity by 54 per cent and laying period by 49 per cent (Table 1) as compared to extensive system. There was significantly lower egg mass production by 23.6% and significantly lower egg weight by 23.7% in free range system of Andamani duck (Table 2). The significantly higher egg weight and egg mass is positively correlated with body energy reserve that has

been reflected in higher adult body weight of layers under intensive system. Confined movement of Andamani duck under intensive system along with balanced feed might have contributed to this statistically better production performance. The positive correlation between body weight and egg weight has been reported in maximum of the genotypes and the present observation opines with the similar reports of other authors in local genotypes of poultry (Kirikçi *et al.*, 2004; Isaac UC and Obike MO, 2020). These authors have suggested for efforts to be made for improving body weight of indigenous poultry and egg weight that has correlation with other egg quality traits such as egg mass. The same concept is applicable to native Andamani duck also. The intensive system for Andamani duck has caused higher adult body weight that has positive correlation with egg production traits.

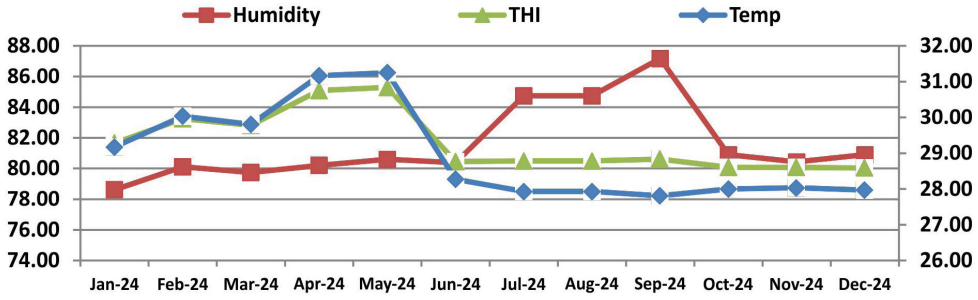

Fig. 1: Thermal humidity index under micro climatic condition of intensive system

Table 1: Body weight of Andamani duck under Intensive system Vs Extensive system

Body weight (Kg)	Intensive system	Extensive system
Pullet - Growers	$1.4^{a} \pm 0.560$	$0.952^{b} \pm 0.643$
Age at sexual maturity	$1.82^{a} \pm 0.280$	$1.179^{b} \pm 0.202$
laying period	$2.10^{a} \pm 0.160$	$1.413^{b} \pm 0.461$

Table 2: Egg production performance of Andamani duck under Intensive system Vs Extensive system

Management	Hen housed egg production (Total number of eggs per hen) ^{NS}	Egg weight (Gms)	Egg mass (Kg per hen)
Intensive system	271.63±3.32	$59.41^{a} \pm 1.10$	$1.609^{a} \pm 0.12$
Extensive system	265.25±1.65	$47.95^{b} \pm 0.69$	$1.271^{b} \pm 0.15$

The biochemical enzyme activities such as AST, ALT and ALP reflected their physiological harmony with the intensive system. The serum enzyme activities of Andamani duck under intensive system are given in the Table 3. The evaluation of the serum enzyme activities has a tremendous value for diagnosis of the different diseases (Kaneko *et al.,* 2009). Majority of metabolism and detoxification takes place in liver. Liver health is evaluated by sero biomarkers such as AST, ALT and ALP as and when the liver is damaged, these enzymes are secreted by hepatocytes into the blood stream (Hang *et al*., 2019). Alkaline Phosphatase (ALP) level was significantly higher under intensive system in comparison to free range system. It is a well proven report that the high level of phosphatase has attributed to higher egg mass production with intensive system (Wilcox. 1965; Singh *et al.,* 1983) due to its stimulating effect on osteoblastic activity that is required to reduce the dietary calcium in-sufficient (Bell, 1960). The hepatobiliary indicator enzymes such as AST and ALT in the present study were significantly

lower in intensive system that is reflecting the healthy nature of liver under the system where as Andamani ducks under free range system are prone to liver damage because of their feeding nature on sand and stones from fields (Huang *et al*., 2018) and hence higher level of these enzymatic activities in Andamani duck from free range system (Sujatha *et al.,* 2021). The serum protein level of Andamani duck under intensive system was recorded higher than its level under free range system (Sujatha *et al.,,* 2021) and Anil *et al.,* (2017), Madhan Kumar *et al.,* (2018), Snehangsu *et al.,* (2017), Kalita *et al.,* (2020), Ismoyowati *et al.,* (2012), Olayemi, *et al.,* (2006) and Kavitha *et al.,* (2020) in the other indigenous ducks. The higher level of serum protein reported in the present study might be due to balanced feeding under controlled environment. There was a significant reduction in serum cholesterol in intensive system that has been confirmed by Wang *et al.,* (2023). There was no significant difference in serum creatinine level between two systems of rearing. Serum cholesterol was significantly lower by 23.5% with intensive system of management. The sero stress biomarkers cortisol and HSP 70 were significantly lower under intensive system by 30% and 17% respectively (Table 4) as compared to free range back system. Andamani ducks are stress under back yard condition in searching of feed and exposes to thermal stress more than intensive system with *ad-libitum* feeding and shadows. The sero cytokine biomarkers viz., IFNγ and MHC were significantly higher in Andamani ducks under intensive system by 13.80% and 26.00% respectively ((Table 4) in comparison with backyard system of rearing. Interferrons (γ) are pleiotropic cytokines secreted by T-lymphocytes and natural killer cells and has positive influence on the immune response particularly antiviral immunity (Schroder *et al.,* 2004). Duck IFN-γ gene as an adjuvant enhances the efficacy of DHBV preS/S DNA vaccine resulting in comparatively better level of sero IFNγ under intensive system may attribute to ability of inhibiting the duck viral hepatitis B virus (Schultz and Chisari, 1999; Long *et al.,* 2005). Studies have shown that rearing system has significant influence on the immune response to vaccine in various breeds (El-Edel *et al.,* 2015), and has affected the gene expression of toll-like receptor (Kolluri *et al*., 2014). The record of higher interferon-γ and MHC levels in present studyindicating a better immune status of Andamani ducks under intensive rearing is also supported by Guo *et al*. (2021) who also reported increased serum levels of interferon- γ improving duck immune function under confined rearing system.

Table 3: Sero biochemical profile Andamani duck under Intensive system Vs Extensive system

Sero biochemical	Intensive system	Extensive system
Protein (g/dl)*	7.65^{a}± 0.47	5.56^{b}± 0.26
Cholesterol (mg/dl)*	173.4^{b}±0.82	202.00^{a}± 2.16
Alkaline phosphatase (U/L)*	74.61^{a}±0.27	52.44^{b}± 0.69
Creatinine (mg/dl) ^{NS}	2.52± 0.11	2.4 ± 0.10
Aspartate Amino transferase (U/L)*	202.40^{b}±0.13	312.22^{a}± 0.46
Alanine transaminase (U/L)*	86.47^{b}±0.73	106.78^{a}± 0.56

Table 4: Sero stress and immune biomarkers Andamani duck under Intensive system Vs Extensive system

Types of rearing	Sero stress biomarkers		Sero cytokine biomarkers	
	Serum cortisol (ng/dl)*	HSP 70 (ng/ml)*	INFγ (pg/ml)*	MHCg (ng/ml)*
Intensive system	1.88^{b}± 18.64	5.42^{b} ±0.4	226.43^{a} ±3.6	9.91^{a} ±1.4
Extensive system	2.54^{a}±11.34	6.52^{a} ±0.8	198.51^{b} ±1.8	7.86^{b} ±2.4

Conclusion

Transition from free range system to semi intensive system with balanced feeding of Andamani duck rearing has improved the body weight gain in grower pullets and during laying period. Intensive system has reduced thermal stress in terms of reduction in sero stress biomarkers of cortisol and HSP 70 and improvement in sero immune biomarekers of MHCs and INFγ. The intensive floor rearing of Andamani ducks with balanced feeding and provision of pond facility is the best scientific, suitable and improved managemental practice for Andmani duck.

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