# ADVANCED PRODUCTION SYSTEM FOR NATIVE NICOBARI FOWL AND ITS CONSERVATION IN A&N ISLANDS

**T. Sujatha, A.Kundu, Jai Sunder**

**DIVISION OF ANIMAL SCIENCES**
**ICAR-Central Island Agricultural Research Institute**
Port Blair – 744 101
Andaman and Nicobar Islands

# Advanced production System for Native Nicobari fowl and its conservation in A&N Islands

**T. Sujatha**
**A.Kundu**
**Jai Sunder**

Division of Animal Sciences
ICAR-Central Island Agricultural Research Institute
Port Blair – 744 101
Andaman and Nicobar Islands

**Dr. Anandmoy Kundu**
Director (Acting)

# FOREWORD

Native chicken is the only source to supply 100% of the total chicken meat requirement of more than 50 per cent of rural farming community of A&N Islands. Desi birds including Nicobari fowls comprising of native chicken production at backyard level contribute significantly to nutritional security of islands' farming community. As per the 19th census (DAHVS, 2012), the total indigenous poultry population in A&N Islands has been estimated to 10,58,400 that is 98% of the total 10,80,000 poultry population of these Islands. In view of changing climatic scenario, due importance is thrust upon the conservation and propagation of native poultry germplasms. The population of native Nicobari fowl is on the declining trend. The native poultry production, being integral component in the nutritional security,must be improved by studying the various bottlenecks present in the rural poultry production system in these Islands. Hence, knowledge onhousing, feeding and health management of native indigenous Nicobari fowl for the improvement of native poultry breeds and their conservation for future use on community basis should be given due concern.

This book on ''**Advanced production System for Native Nicobari fowl and its conservation in A&N Islands''**provides a wealth of useful information on how to improve the production of native Nicobari fowl through scientific rural farming system. It is a practical book with chapters on hatching, housing, nutrition and health. I sincerely hope and believe that the knowledge, tools and experiences offered here will be a valuable

resource for native poultry keepers. Above all, I hope that it will inspire readers to implement the package of practices narrated in this book.

I congratulate the scientists for compiling such useful practical information for the mass multiplication and conservation of native Nicobari fowl. I assure that this book will be a valuable guide for those working with tribal farmers. I sincerely believe that this information will be very much received by farmers and un employed youthsto take up the native poultry production as a tool towards doubling farmers income.

**(A.Kundu)**
Director (Acting)
ICAR-CIARI, Port Blair

# CONTENTS

## Chapter I

# 1.1 AVIFAUNA OF A&N ISLANDS

The Andaman and Nicobar group of Islands are situated about 1200 km away from mainland India in the Bay of Bengal. Geographically, these islands are distinguished in two groups, i.e. the Andaman group and the Nicobar group, separated by the deep $10^0$ Channel with a width of about 150 km. The total

land area of all these Islands is only about 8249 sq.km, of which about 86% is covered by lush green tropical rain forests. These Islands have a typical maritime climate and are endowed with both South-West and North East monsoons with an average rainfall of 3100 mm distributed over 8 months. The year round relative humidity varies between 70-90% with temperature of 18-32$^0$ C.

The flora and fauna of these Islands is still insufficiently known. The avifauna of Bay Islands is unique. Long period of isolation from mainland has brought genetic variation in the genome of the Islands avifauna. During last two decades, poultry population in these Islands has been increased mainly due to increase in non-descript population. The total poultry population of these Islands is 1080022 (AHVS, 2012) which includes fowl (improved and Desi), ducks and others. Chicken germplasm available are Nicobari fowl, Frizzle fowl, Naked neck, non-descript, Aseel, Barred Desi Burmese fowl and Red jungle fowl. These indigenous birds are well adapted to the Island ecosystem and survive well in local free-range condition.

### 1.2 Genesis of Poultry Farming

The first attempt to study about livestock in these islands was made in the year 1840 by Heller. He surveyed the Out ram and Middle Button Island and sailed through on the east coast of Middle Andaman. Thereafter, Quigley (1850) and Kurz (1857) also surveyed the Andaman but systematic study was, however, made only in 1870 when Ball visited several of Andaman and Nicobar. In 1887, British established a dairy farm with some poultry birds in South Andaman, to fulfil the milk, meat and egg requirement for their military personnel's. Later,

the modern poultry keeping was given a new beginning in 1973 and the real spadework for the development of poultry in the island was done in fifth five year plan (1975-80). The very first step towards scientific poultry farming was taken in 1980 with the establishment of Government Poultry farm and a hatchery in South Andaman. Central Island Agricultural Research Institute, Port Blair, with its emergence in 1978 also contributed a lot for the development of poultry in the islands by providing scientific and extension services to the farmers.

Systematic history of chicken farming in Andaman is not available. Hence, with certainty it cannot be told when this activity was introduced or started. Present desi poultry birds of these islands depict the possession of red jungle fowl (*Gallus gallus*), peafowl and pheasants. The avifauna particularly rasorial birds also got separated and were confined on particular Island. That is why a few islands which are less disturbed by intruders, still possess their heritage birds though very few in numbers. The intrusion of Mongolian, Chinese, Burmese, Javanese, Japanese, Britishers, and Sumantrans with their poultry birds intermingled to such an extent that present desi poultry have lost their identity.

The poultry population of the islands is confined to non-descriptive birds and most of them are crosses except a few indigenous birds such as Naked neck, Red Jungle Fowl and Nicobari fowl which could maintain to some extent their genetic identity largely due to their habitat being in an isolated remote islands. Studies of Central Island Agricultural Research Institute, Port Blair show that short-legged dwarf Nicobari fowl of Nicobari tribes is often better than most of the indigenous breeds of India under rural husbandry practices.

### 1.3 Diversity of Avifauna

Genetic diversity is the part of our natural heritage. The manner in which we manage our biodiversity today will determine the quality of the life we ordain for future. The sustainability of any ecosystem, whether natural or man-made depends on the diversity of animal, bird and plant found in it. Due to human pressure many bird, animal and plant species have already been lost forever. Many more are on the brink of extinction. Therefore, the conservation of biodiversity has to become a great concern for all.

The use of improved breeds through cross breeding has lead to the dilution and displacement of local “unimproved” germplasm. Sufficient genetic flexibility has occurred in poultry breeds due to market demand and environmental change. In general indigenous poultry breeds well adapted to harsh environment conditions are often replaced by imported ones which though are high producers but not as successful as our own breeds at home. The indigenous poultry breeds, on which India and Asia have depended for centuries are being lost and some native breeds of chickens and ducks are in extinction and many others are endangered. Because of industrial poultry, the need for conservation is greater in poultry species than it is in domestic animals. We do not mean that there is complete blackout, some efforts here and there to conserve the native breeds of poultry are going on but they are meagre. Much more concentrated efforts are required to protect the rapidly dwindling indigenous poultry genetic resources throughout the country, specifically in the remote islands where chances for getting rare gene pool are more and human interference are negligible.

The avifauna of Andaman and Nicobar Islands is unique showing multidimensional affinities to Assam and Burma in the North, Thailand and Malaysia in the East and Sumatra and Java towards the south. Long period of isolation from mainland has brought genetic deviation in the genome of the Island avifauna. Ecologically, the whole group of islands is a huge evolutionary laboratory. So far 243 species and sub species of birds have been identified which have been broadly classified as follows:

| | | |
|---|---|---|
| Migrant | - | 100 |
| Residents | - | 43 |
| Resident endemic | - | 95 |
| Introduction | - | 05 |

The gradual increase in human population and their activities in these islands may in due course play havoc to the rare unique avi-fauna of these islands. Genetic potential of native germplasm is a reservoir of minor and major genes which affects adaptability. However, such native genes are neglected due to limited commercial value and economic concerns, over ride conservation efforts. The birds of Andaman and Nicobar are of great significance because of large period of isolation of these islands among themselves and from its main continental land mass.

### 1.4 Value of Native Germplasm

In the era of industrialisation, exotics breeds are mostly preferred because of the belief that hybrids are better than indigenous.

Scientific poultry keeping in India was first advocated by Christian missionaries towards the beginning of the 20$^{th}$ centuries A.D. The first missionary poultry farm was established

in Etah, U.P. in 1912. Even before that in 1910, an All India Poultry club was started with Sir Arcot Butler as its president. During that time onwards, the Indian poultry club made serious attempts to popularize foreign breeds in India, which were superior to desi fowls.

This is borne out by the fact that in 1929 several untested pure Bursa pullets from united provinces presently known as Uttar Pradesh Govt. Farm from Lucknow were sent to the National Egg laying test in England and it surprisingly performed very well and missed the distinction of being the highest egg producer by only one egg (Chopra 1981). Moreover, of the 179 eggs the Bursa pullet laid, 170 were considered 'A' grade. This was acknowledged by Mrs. Fawkes in the Feb., 1933 issue of the "Indian poultry Gazette" paid fulsome tribute to the Bursa in her own words. "The little gallent hens" from Lucknow are upholding the honour of their country (India) in Europe. In fact, our birds were among the 4,000 pedigreed birds from all countries many of whom they out classed both in number and size of eggs.

Also in another test held at Govt. Experimental station Kakinada (A.P) even the Aseel bird, which do not have the body built for laying, produced increased number of eggs by selective breeding. Kadkanath, a unique poultry bird of India, popular for her black meat is still being conserved at Central Avian Research Institute, Izatnagar

The *laissez- faire* attitude towards so called scavenger native birds leads to indiscriminate crossing which threatens the genetic potential of native breeds. Important genes are being diluted and even lost. There are several evidences that

exotic birds are always not the best, as they require stringent management for optimum performance. Native fowl require neither vaccination nor medication against outbreaks of diseases such as New castle disease, fowl pox and Mareks disease but nevertheless show high resistance. They are also adapted to environmental stresses like scorching heat, high humidity and temperature fluctuations whereas, exotics are not. Native fowl go deep into scarp in search of food and owing to lower body weight they require less food for maintenance. Exotic breed need well-balanced feed for survival and production and are poorly adapted for scratching in bush land.

Indigenous birds have the ability to consume a high fibre diet and thus reduce competition with human beings for scarce food grains; exotics often need foodstuffs of a quality that could be fed directly to human beings. Native fowls are good mothers as they go under brooding and take care of their chicks whereas, exotic do not go under brooding. A large part of rural India where there is no electricity and possibility of scientific poultry farming is remote, the character like broodiness is a boon for our farmers and needs to be maintained in native poultry birds. Such a unique character of indigenous chickens has been put on stake because of the desire to increase productivity and finally economic gain.

Chickens have native origin are usually black and brown in colour or their combinations. Such birds can hide themselves in the bushes putting themselves at less risk of predators while the birds of exotic origin are generally of white colour exposed to more risk of predators in open range system. In general, people still believe in the idea that desi eggs and meat are more nutritious and tasteful than exotic one and therefore it fetches

more price. People of our country have liking for the eggs and meat of native birds. Hence, the improvement in production system of native birds has economically significant impact in the nutritional security of rural farming community.

### 1.5 Islands' poultry production

Poultry production in islands is still exclusively a rural occupation and a large percentage of the people engaged in belong to the poorer section of the rural community. Poultry farming is in its infancy and majority of eggs in the market come from hens kept in semi-intensive systems and backyard operations. Farmers do not have sufficient knowledge on scientific intensive farming system as they are modern technologies developed in the field of poultry science. However of late there has been an increasing awareness among the farmers to adopt scientific production system for poultry. Tehsil wise poultry population as per livestock census 2012 has been tabulated below.

## Tehsil/District wise poultry population as per Animal Husbandry & Veterinary Services (2012) census

| Name of Tahsil / District | Poultry | | | | | |
|---|---|---|---|---|---|---|
| | Backyard Poultry | Turkey | Quails | Other Poultry | Farm Poultry | **Total Poultry** |
| Diglipur | 207024 | 9 | 0 | 0 | 2237 | **209270** |
| Mayabunder | 75704 | 3 | 0 | 0 | 2061 | **77768** |
| Rangat | 115813 | 4 | 140 | 43 | 2189 | **118189** |
| **N & M Andaman Total** | **398541** | **16** | **140** | **43** | **6487** | **405227** |
| Port Blair - Urban | 14573 | 18 | 152 | 2 | 865 | **15610** |
| Port Blair - Rural | 61899 | 12 | 405 | 745 | 274601 | **337662** |
| Ferrar Gunj | 69730 | 36 | 34 | 430 | 73328 | **143558** |
| Little Andaman | 80440 | 3 | 365 | 30 | 6855 | **87693** |
| **South Andaman Total** | **226642** | **69** | **956** | **1207** | **355649** | **584523** |
| Car Nicobar | 31235 | 13 | 0 | 0 | 0 | **31248** |
| Nancowry | 35568 | 0 | 0 | 20 | 1225 | **36813** |
| Campbell Bay | 21655 | 0 | 0 | 0 | 556 | **22211** |
| **Nicobar Total** | **88458** | **13** | **0** | **20** | **1781** | **90272** |
| **Total A & N ISLANDS** | **713641** | **98** | **1096** | **1270** | **363917** | **1080022** |

(Department of Animal Husbandry & Veterinary Services, 2012)

# Chapter II

## 2.1 Origin of Nicobari Fowl

The avifauna of the islands is essentially Indian and Indo-Burmese, Indo-Malayan and Indo-Javanese. Hence, they are lacking more or less entirely a large proportion of its characteristic genera, many of which are the strongest and most widely distributed and to which the climate would appear in every way congenial. The Nicobar's connection with the mainland has been the longest separated that they have been disconnected among themselves for a great extent of time. At a later period, the Andaman was cut off from the continent and the process by which it has been broken up in to islands.

## 2.2 Habitat

In general, these fowls are mostly free ranging and housing is only at night. Mostly, they live in the trees during night. In tribal areas sometimes the birds take shelter at night in the corner of the house along with the owner. The type of housing

is generally Kutcha and made up of locally available materials and single storied. Fowls are provided with small bamboo basket for egg laying.

Nicobari fowl is a scavenging bird adapted to hot and humid conditions of the island. The bird in the morning after laying walks to long distances in the forest and neighbourhood in search of food and comes back only at dusk. It takes shelter on some trees, bushes or inside a coop nearby the house. In its natural habitat it can fly to some extent and protect from predators by flying and taking shelter on a tree. Nicobari hen in the field condition is an efficient mother having broodiness characteristics. The broodiness character of the bird helps the farmer to multiply the bird. In the male fighting instinct is very high. The males have to fight amongst themselves to get a pecking order in a flock. The mating takes place mostly in morning hours and also sometime in evening.

### 2.3 Characterisation of Nicobari fowl

#### a. Physical characteristics of Nicobari fowl

Nicobari fowl is locally known as Takniet (in Nicobari language) means short legged and hyum means chicken. Short legged Nicobari fowl could be traced back to the origin in Nicobar group of Islands. The origin of Nicobari Fowl seems to be from crosses of different exotic and indigenous fowl of Nicobar group of Islands. Nicobari tribes probably might be responsible for development of this breed under natural condition. Most closely related breeds seem to be Red jungle fowl and Rhode Island Red. There are three varieties of Nicobari fowls.

They belong to *Gallus domesticus* species. Nicobari fowl is a brownish matty coloured hardy bird. They are medium sized with short leg. They have compact body conformity. These birds

are mostly single combed. Rarely pea combed birds are also found. Wattles and ear lobe are pinkish in colour. Earlobes are comparatively larger and fitting close to head. They have short and thick neck, black plumage tipped with brown shade, breast bulging in front, brownish matty, heavy and broad and medium size tail and long saddle feathers fitting well with tail. Wings are large, strong and well folded, front and bows are lustrous brown or black in colour and primaries and secondaries are black edged.

The bird has pinkish white, thick set and well curved beak; medium sized, heavy and broad head; medium sized straight, upright, deeply serrated reddish comb, which is generally single and rarely pea. Eyes are bold, pearly, little, dark and round in shape. Leg and toes are thick, broad and well – set upper thighs covered with feathers. Lower thighs and shanks are small and as a result the birds walk with a sweeping movement

The short leg character is dwarfism. Shank length at 10 weeks of age varies from 3.50 to 3.85 cm.

**b. Bio-Chemical Characteristics**

Investigation on genotype differences of Nicobari fowl with other poultry birds were made by studying plasma protein polymorphism. The plasma proteins studied were transferrin and pre-albumen. Transferrin polymorphism in blood plasma of Nicobari fowl, white leghorn and black Australorp indicated that Transferrin locus (Tf) is controlled by three co-dominant alleles $Tf^A$, $Tf^B$ and $Tf^C$, six transferrin phenotypes (AA, AB, AC, BB, BC and CC) were observed during the studies. Phenotypes, BB, CC and BC were absent in Nicobari fowl, white leghorn and Black Australop, respectively and their respective phenotypic frequencies were 0.00, 0.02 and 0.04 in the population studies. Absence of BB, CC and BC phenotypes from Nicobari, white

leghorn and Black Australop respectively indicated difference in genomic base among the breeds. Pre albumen polymorphism studies in Nicobari, white leghorn and Black Australop indicated 3 phenotypes and their synthesis being determined by two alleles viz $Pa^A$, $Pa^B$ situated at an autosomal locus Pa. Existence of different among pre-albumin, transferring and albumen loci was observed. Genetic difference among the birds could not be explained on the basis of pre-albumen phenotypes.

### c. Serum protein and enzyme profile of chicken

| Parameters | Nicobari fowl | White Leghorn |
|---|---|---|
| Total protein (g/100ml) | 8.80 | 8.25 |
| Albumin (g/100ml) | 2.78 | 2.67 |
| Globulin (g/100ml) | 6.02 | 5.58 |
| A:G ratio | 2.16 | 2.09 |
| Glucose (mg/100ml) | $203.00^a$ | $189.50^b$ |
| Acid phosphatase (KA unit) | 3.02 | 1.76 |
| Alkaline phosphatase (KA unit) | $38.18^a$ | $46.13^b$ |
| SGOT (KA unit) | $151.50^a$ | $137.2^b$ |
| SGPT (KA unit) | $14.60^a$ | $11.12^b$ |

Different superscript shows significant differences ($P<0.05$)

Significantly higher amount of glucose, albumin, acid phosphatise and serum glutamine oxalo-transaminase (SGOT) and SGPT (Serum glutamine phospho-transaminase) were found in Nicobari fowl as compared to white leghorn. Higher concentration of serum constituent enzymes is an indication of low productivity and higher concentration of protein and glucose may be an indicator of better quality of eggs in terms of organoleptic test in indigenous Nicobari fowl as compared to white leghorn.

## d. Hematological index

| Blood constituents | Pullets | Cockerels |
|---|---|---|
| Erythrocytes/mm$^3$ | 2.63x10$^6$±0.43 | 2.67x10$^6$±0.34 |
| Leucocytes/mm$^3$ | 3.28x10$^4$±0.37 | 3.31x10$^4$±0.40 |
| Hemoglobin (g/100) | 8.11±0.28 | 8.8±0.26 |
| Packed cell volume | 31.55±2.76 | 31.73±3.71 |
| Erythrocytes sedimentation (mm/hr) | 31.17±0.22 | 3.06±0.31 |
| Lymphocytes (%) | 66.38±4.38 | 67.88±5.36 |
| Monocytes (%) | 6.17±0.11 | 5.37±0.47 |
| Heterophils (%) | 20.43±2.16 | 21.69±1.12 |
| Eosinophils (%) | 4.39±0.79 | 3.16±0.34 |
| Basophils (%) | 2.71±0.37 | 1.91±0.52 |
| Mean corpuscular volume (μ$^3$) | 120.31±8.97 | 118.76±6.36 |
| Mean corpuscular haemoglobin concentration (vol/percent) | 25.68±2.54 | 27.94±3.17 |
| Mean corpuscular haemoglobin (Micro-Microgram) | 30.99±2.24 | 33.26±1.99 |

## f. Production and reproduction traits Egg production characteristics under field (village) and farm conditio

| Traits | Under field (village) | Deep litter | Cage |
|---|---|---|---|
| | Mean/ range | Mean/ range | Mean/ range |
| (1) Age at first egg (days) | 201.63a±0.78, Range 143-280 | 188.10b ± 1.06 Range 175-196 | 186.09b ± 11.56 Range 181-192 |
| (2) Annual egg production (in number) | 115.7 ± 1.09 Range – 112-237 | 140± 2.12 Range – 120-150 | 159.26 ± 9.07 Range – 157-169 |
| (3) Age at 50% production (days) | 218.41 ± 2.16 | 215.70 ± 4.16 | 210.50 ± 5.25 |
| (4) Age at culling (days) | 467.3 ± 5.08 Range – 301-572 | 537.01 ± 4.11 Range – 501-581 | 560.10 ± 80.46 Range – 555-600 |
| (5) Egg weight (g) | 44.01 ± 0.61 | 45.02 ± 1.62 | 44.65 ± 2.13 |

## Comparative egg production of various indigenous poultry breeds of India

| Name of Poultry breed | Location | Annual Egg production |
|---|---|---|
| Aseel | Andhra Pradesh | 91 |
| Kadaknath | Madhya Pradesh | 75 |
| Barred Desi | T.N, A.P and A&N Islands | 91 |
| Frizzle | Hot & Humid regions | 89 |
| Naked neck | Hot & Humid regions | 98 |
| Brown Nicobari | A&N Islands | 148 |

## Reproduction characteristics

| Traits | Field | Farm (deep litter) |
|---|---|---|
| 1. Broodiness | Sometimes | Rare |
| 2. Fertility (%) | 87.13 ± 3.42<br>Range-66-98 | 76.61 ± 1.01<br>Range-62-86 |
| 3. Hatchability of total eggs (%) | 76.02 ± 1.60<br>Range-40-90 | 68.87 ± 1.32<br>Range-60-86 |

## Growth characteristics

| Body weight (g) | Field | Farm (deep litter) |
|---|---|---|
| At hatching | 32.61 ± 0.47<br>Range- 25-45 | 34.01±0.58<br>Range-31-46 |
| 8$^{th}$ week | 238.93 ± 5.62<br>Range-145-315 | 268.16 ± 9.61<br>Range -185-325 |
| 12$^{th}$ week | 399.55±4.69<br>Range-172-465 | 426.16±7.12<br>Range -335-640 |
| At maturity | 913.29 ± 10.5<br>Range- 660-1445 | 1163.16± 16.61<br>Range- 935-1360 |
| At slaughter | 1200 g (Male)<br>900-1000 g (Female) | 1801.01±21.16 (Male)<br>1332.23±22.61 (Female) |
| ge at slaughter | 9 months (Male)<br>2 years (Female) | 8 months (Male)<br>1.5 years (Female) |

## g. Performance of Brown Nicobari fowl under intensive system

The body weight of day old chicks and at 20 weeks of age of Brown Nicobari were 32 kg (± 0.20) and 976 g (±9.01), respectively. Shank length at 10 weeks of age was 3.7 cm (±0.06) The egg production per annum and average egg weight were 142 (±3.0) in number and 42.0g (±0.5), respectively. Laying period mortality was 6.4% (Ahlawat *et al*., 2003). The weight of Black Nicobari at day old, 20 weeks of age and at sexual maturity were 37 (±0.3), 1008 (±10.04) and 1233 (±13) g, respectively. The egg weight and shank length at 10 weeks of age were 44 (±0.41) g and 3.7 (±0.06) cm respectively. The laying period mortality of these birds was 4.9% (Chatterjee *et al*., 2003). The egg production of White Nicobari was highest among all the indigenous breeds of India. The White Nicobari was best layer among the three strains of this breed. The weight of White Nicobari at day old, 20 weeks of age and at sexual maturity were 37 (±0.3), 1008 (±10.04) and 1233 (± 13) g, respectively. The egg production of this strain per annum was 157 (±7.0) in number. The egg weight and shank length at 10 weeks of age were 44 (±0.41) g and 3.7 (±0.06) cm. The laying period mortality of these birds was 4.9% (Chatterjee *et al*., 2003). The egg production of White Nicobari was highest among all the indigenous breeds of India. The White Nicobari at day old, 20 weeks of age and at sexual maturity were 35 (±0.3), 918 (±9.0) and 1082 (±13.0) g, respectively. The egg production of this strain per annum was 162 (±7.0) in number. The average egg weight and shank length at 10 weeks of age were 43 (± 0.5) g and 3.8 (±0.07) cm. The laying period mortality of these birds was 5.1% (Chatterjee *et al*., 2003).

**h. Carcass quality traits of Nicobari fowl expressed as percentage of eviscerated weigh**

| Cut of parts | Black Nicobari | Brown Nicobari | White Nicobari |
|---|---|---|---|
| Wing | 9.91± 1.22 | 11.38±0.73 | 10.40±0.40 |
| Back | 23.75±1.08$^{a}$ | 20.65±0.70$^{b}$ | 21.92±0.71$^{a}$ |
| Neck | 7.27±0.28 | 8.22±0.58 | 8.38±0.54 |
| Legs | 38.89±1.02$^{a}$ | 35.21±0.58$^{b}$ | 35.10±0.76$^{b}$ |
| Breast | 20.19±0.92$^{b}$ | 24.52±1.17$^{a}$ | 23.31±1.18$^{a}$ |

Means bearing different superscript in a row differ significantly ($P<0.05$)

**i. Mortality**

Mortality rate was highest during brooding period. This mortality can be checked by adopting proper management. During laying period mortality had been found to be very less under both backyard and intensive management.

**j. Stress tolerance**

Andaman and Nicobar Islands have hot and humid climate with temperature variation from 23.3˚C to 30.5˚C and humidity from 74-90%. However, the mortality of Nicobari at field condition is low except the first three weeks of life.

**k. Disease resistance**

Nicobari fowl is having higher immunity towards Ranikhet Disease, Marek's disease, IBD, Salmonella, E.Coli and Coccidiosis (Rai and Ahawat, 1995). It was found that humoral response to Sheep Red Blood Cells was highest in Brown Nicobari followed by Black and White Nicobari and exotic bird (i.e ILI-80) The mortality % in an outbreak of IBD in Brown

Nicobari was lowest (27.8%) followe by White Nicobari (42.6), Black Nicobari (50.6) and highest in the crosses of ILI-80 with Black Nicobari (56.6%), which indicated comparatively higher resistance of Brown Nicobari to IBD (Jai Sunder *et al*., 2004). Generally, vaccination against poultry disease is not provided to the birds under farm and field condition to indigenous fowl of A&N Islands.

**I. Genetic traits**

**Heritability Estimates for various traits in white Nicobari fowl**

| Traits | $H^2S$ | $H^2D$ | $H^2S+D$ |
|---|---|---|---|
| Day old Body wt | 0.29±0.19 | 0.79±0.32 | 0.54±0.23 |
| 4 week Body wt | 0.27±0.12 | 0.77±0.31 | 0.52±0.21 |
| 8 week Body wt | 0.21±0.19 | 0.39±0.22 | 0.30±0.18 |
| 10 week Body wt | 0.19±0.21 | 0.44±0.29 | 0.32±0.20 |
| SL at 10 weeks | 0.29±0.17 | 0.83±0.39 | 0.56±0.27 |
| 20 week Body wt | 0.11±0.12 | 0.55±0.35 | 0.32±0.21 |

Padhi (1999) Ph.D. thesis.

**Heritability estimates of production traits**

| Traits | $H^2S$ | $H^2D$ | $H^2S+D$ |
|---|---|---|---|
| Age at sexual maturity | 0.26±0.06 | 0.24±0.09 | 0.22±0.10 |
| Wt. At sexual maturing | 0.32±0.13 | 0.34±0.06 | 0.33±0.11 |
| Annual Egg production | 0.18±0.04 | 0.22±0.11 | 0.19±0.09 |

From Ahlawat and Rai (1992)

The heritability estimates computed from dam component of variance were higher than those computed from sire component of variance in almost all the traits under study. This increase in heritability of dam component is perhaps due to

maternal effect. Lower heritability estimates of egg production in Nicobari fowl indicated that there might not be much of additive genetic variance for egg production because of poor genetic base, small population size, continuous selection for egg production and sudden change in farming system from open range to deep litter system

The genetic and phenotypic correlation between different juvenile traits are moderate to high in Nicobari fowl indicating the high interrelation of one juvenile traits with the other.

**Heterosis percent in crossbreds**

| Traits | BN x WLH | WLH x BN |
|---|---|---|
| 20 week B.wt. | 5.26 | 5.41 |
| ASM | 5.64 | -3.95 |
| WASM | 2.41 | 6.42 |
| Egg. Wt | -1.05 | 3.16 |
| Annual egg production | -0.53 | 20.86 |
| PCR | -2.38 | 0.18 |
| Laying period Mortality % | -58.62 | -44.83 |

The annual egg production showed heterosis percent of 20.86 in WLH x BN crossbred indicating superiority of this over BN x WLH crossbred and pure Nicobari fowl. The heterosis can be exploited in crossbred for improving the higher egg production.

**m. Molecular characterisation of Nicobari fowl**

Nicobari fowl native of Andaman & Nicobar Islands are found to be highly resistant against many of the dreaded diseases of poultry like MDV, NDV, FPV, IBDV etc. Development of molecular markers will be foundation step towards the subsequent identification of disease resistant genes in Nicobari fowls as well as sustainable exploitation of these unique

germplasm for genetically defined up-gradation of exotic birds. Higher immunity trait in Nicobari fowl has been studied to identify the markers to help in conservation of this highly precious indigenous disease resistant Nicobari fowl of these islands. A Total of 25 decamer primers were screened among Brown, Black and White Nicobari and a strain of White Leghorn of which 24 primers amplified the genomic DNA, generating 2000 to 200 bp bands. Ten primers generated reproducible and different RAPD profiles. A total of 94 bands were amplified and 30 polymorphic bands (32%) were produced. The number of polymorphic loci ranged from 1 to 5. Brown Nicobari showed higher genetic similarity (0.85) than either Black (0.80) or white Nicobari (0.82). Brown Nicobari showed higher genetic similarity with Black Nicobari (0.87* 0.29). The native breeds showed the least genetic distance with each other while White Leghorn appeared to be most different from the native breeds.

## Chapter III

# FARMING OF NICOBARI FOWL

### 3.1 Rural Poultry production system

In India poultry farming under backyard system is as old as its civilization. Backyard poultry production is traditional in most rural and peri-urban areas of India. Rural poultry farming by and large is a low input venture and is characterized by indigenous night shelter, scavenging system with little supplementary feeding, natural hatching of chicks, less productivity of birds and no health care practice. The traditional poultry farming in villages is the primary source of animal protein and supplementary income for more than 50 percent of the rural population of this country. The cheapest egg and poultry is one which is produced in the backyard or semi-scavenging system.

Rural poultry in India is characterized by small flock size consisting of 5-10 pre-dominantly non-descript birds maintained in extensive system under zero input conditions. But fetch the owners much needed animal protein and supplementary income. It is significantly contributing to the nutritional and livelihood security amongst rural poor. Maintaining small flock of local non-descript fowls under free range condition by landless poor, small and marginal farmers is a common sight in rural areas. These birds are very popular due to their adaptability to local agro climatic conditions and management practices with prominent brooding behaviour and mothering ability.

Housing systems for rural poultry production range from crudely constructed houses, to bamboo baskets, wire mesh or bamboo cages placed in the backyard to systems of putting bamboo or wooden cages on tree tops, wooden poles or along the roof. Saving the birds from predators is the major objective

of these innovations. Chick loss is about 30%. However, losses among adults are only about 7%. Newcastle disease and lack of facilities for vaccination are the main reasons for losses in chicks. Nutritional deficiency and coccidiosis could be other causes of loss. Loss due to predation by birds and animals (also neighbours) is common. The desi birds are small in size, poor in egg production (40-50 eggs/anum) and with small clutch size.

### 3.2 Role of rural poultry in Agricultural activities

As agricultural laborers, their meager income is not sufficient to meet their daily expenditure on food and education of children. There are many agriculture-related enterprises for generating additional income with low investment. Low cost, less labour intensive backyard poultry based agricultural technology is a lifeline for farmers especially with farm women. If the main crop fails, the farmer can see through the difficult times by selling the birds in his farm. The demand for country eggs and meat in the local market is very high and they command higher market prices than the commercially produced equivalents. The backyard egg or bird gets double the price of commercial eggs and poultry. During festival seasons, it is even higher and eggs with brown shell even fetch better price at Rs. 10-12 per egg. In fact it is comparable to a credit card which helps the farmers when they are in urgent need of money. Also, this type of farming protects the farmers as they need not take loans at high interest rates from private money lenders.

### 3.3 Major constraints in rural poultry farming

The major proportion of total poultry population of these Islands comprise of desi/non-descript with low productivity. With the introduction of the exotic germplasm and the establishment of commercial farm the chance of infection as well as disease incidence of these birds have also increased in the recent

past. It is the time of hour to establish scientific rural poultry farming with indigenous fowls under the per-view of importance of indigenous poultry germplasms in context with continuous climate change.

### 3.4 Advantages of native Nicobari fowl

1. The native indigenous birds of these islands specially the Nicobari fowl is well adapted in the island milieu condition.

2. Survive well under harsh environment of free-range condition.

3. Nicobari fowl is better in immunity specially against RD, MD and IBD and higher in egg productivity of all desi birds under backyard condition.

4. As the Nicobari fowl are having better feed conversion efficiency, their production potential of these fowl can be improved through scientific management at field level.

5. They produce eggs of 130-140 numbers per annum and meat of 1.2 kgs at 20 weeks of age at least possible rearing cost.

### 3.5 Threat to Nicobari fowl

In A&N Islands due to its isolation these Nicobari fowl maintain their genetic identity. However due to the introduction of exotic breeds and loss after Tsunami the indigenous fowl is in the verge of extinction. They are by and large replaced by exotic breeds and this unique indigenous germplasm is in the verge of extermination. Its population at present is below 7000. ICAR-CIARI is maintaining the pure stock of Nicobari fowl. So mass propagation of these native Nicobari birds is essential

through rural poultry farming to rejuvenate its population status in these pristine islands.

### 3.6 Scientific production of Nicobari fowl

The scientifically organized rural poultry will improve the income avenue for resource-poor farmers by helping in food production, improving their livelihoods and food security and reducing malnutrition.

**Major disadvantages in scavenging system of rural poultry**

1. Loss of eggs as birds lay eggs in hidden places which cannot be recovered.
2. Ease in spread of diseases and subsequent heavy mortality.
3. Difficulty in confinement of birds during vaccination.
4. Conducive system for the stray dogs to carry the dead birds to different location and spread the disease in a large area.
5. The chicks and birds are being caught by stray dogs and cats.
6. These are major limiting factor in backyard poultry which necessitates housing / shelter for backyard poultry.

### 3.7 Strategies to improve the economy of rural poultry production

Rural poultry farming has been found to be a subsidiary occupation since antiquity. However, the transition phase has

occurred in rural poultry under the scenario of climatic change. More thrust is being given for conservation and propagation of indigenous animal genetic germplasms. Thus, scientific production of Nicobari fowl could prove to be significant attribute for nutritional security of rural farming community. Such establishment of rural poultry farming with native indigenous Nicobari fowl and large scale multiplication at farm level will restore these indigenous poultry. The following strategies are found to improve the production status of rural farming.

1. Dissemination of suitable package of practices for rural poultry

2. Training is very important tool to impart the knowledge and skill to the poor farm women for enhancement of rural poultry production and thereby socio economic up-liftment of the rural poultry farming community.

3. Supporting the resource poor farm women for initial establishment of input unit and its scientific management.

## Chapter IV

# HOUSING FOR NIOCBARI FOWL FARMING

### 4.1 Low cost shelter

The attention on poultry house, the important area in poultry management has to be intensified at this hour among rural and tribal farmers in A&N Islands. House for Nicobari fowl is very much needed to increase the productivity of hens, to save them from predators, to aid in preventing loss of eggs, to protect them from rain, snow, excessive heat and cold and other inclement weather, to provide feed and water space and nesting facilities.

### 4.2 Key steps in construction of shelter:

Shelters are like rooms with required space to live comfortably, to flap their wings, walk about, and build comfortable nests. Chicken shelters must be clean, hygienic, ventilated and featuring changeable flooring (like sawdust or woodchips).

*i)* *The Right Site:* Poultry house/night shelter should be constructed with proper drainage facility preferably at an elevated site which is highly essential for the places like A&N Islands which receive heavy rainfall. Improper drainage will lead to muddy areas that can promote filthiness and outbreak of disease. The long side of house should face east west direction to avoid direct sunlight falling into the building.

*ii)* *Elevation:* The floor of house should be raised 3 ft above the outer ground level to prevent seepage of water into the house. the floor may be made of cement concrete to prevent damage by rodents and to permit easy and efficient

cleaning; but, as for as, Nicobar Island is concerned, the floor may be made of wooden/any other hard locally available materials.

iii) *Side wall:* The thumb rule is that the long walls on the sides should be of 1 ft high above the floor level with the rest of the area covered with a mesh. As for as our A&N Islands concerned where is the hot humid climatic condition with the maximum rain fall and considering the culture and tradition of tribal community, the walls may be made of bamboo woven for medium term duration or any locally available material. Materials should be durable, strong and close enough to prevent the entry of rodents and predators. Proper and adequate cross ventilation must be assured and secured while constructing the sides of poultry house.

iv) *Roof:* The roof may be thatched (Straw, coconut leaves or arecanut sheaths). Thatched roofs are cheaper but less durable and leak. Hence, to prevent leakage, the slope of thatched roofs must be steeper. Houses with light roof such as sheets are preferred low capacity tribal farmers. The standard height of the roof at eave and ridge is 2.4 m and 3.6 m respectively. The height of the roof should have a lower height of 1.95 m at the eaves. The projection of the roof at the eaves (overhang) should be atleast of 3 ft on either side to prevent direct sunlight and the splashing of rain water into the house.

### 4.3 Building the house

1. Cheap local materials like bamboo, wood, reeds, thatch grass, or clay bricks may be used for making poultry houses.

2. Remove the bark from the wood you use, as parasites often hide behind the bark.

3. The best protection against diseases and parasites is a good hygiene. It is therefore important that it should be easy to clean the house or shelter. It should be high enough for a grown-up person to work inside comfortable. Cleaning will also be easier if the floor in wooden houses is covered with slats.

4. Make the nests and perches easy to remove when cleaning.

5. Houses or shelters may be sprayed or lime washed after cleaning to disinfect and kill parasite eggs from the walls and cracks. You may put some ashes on the floor and in the nests to discourage parasites.

6. Clear the grass and bushes for about 3 meters on all sides of the house to keep snakes and rats away from your chickens.

7. In wooden houses, use slatted, raised floors to remove droppings and avoid predators.

8. Some houses are built on poles, well above the ground to protect the chickens from predators like dogs, rats and snakes, as well as humans.

9. Build your poultry house to prevent possible injury to your birds. Remove any sharp edged objects from the house.

10. The house has to be so large to get sufficient room for the birds and the air inside does not become too heavy with humidity and gasses.

11. A well-constructed chicken house is placed in the shade, has a high roof and windows with wire mesh, providing good ventilation. The door is facing north to avoid direct sun. The door is big enough for a person to enter to clean the house frequently.

### 4.4 Perches

1. Perches are important for chickens to rest during night.

2. Diseases and parasites may attack poultry resting on the floor, and perches often reduce the risk of external parasites entering the feathers at night.

3. Each one-meter perch may roost five adult birds. Perches are best made of bamboo or round sticks to accommodate for the size and structure of the birds' feet

4. To prevent attack of external parasites, the perches may be treated with oil or kerosene, where the perch meets the wall.

## Chapter V

# MANAGEMENT OF NICOBARI FOWL

### 5.1. Artificial brooding for Nicobari chicks

During the first few weeks, chicks are cold blooded; that is, unable to maintain their body temperature. As they grow, they become warm blooded; that is, able to maintain constant body temperature under normal environmental conditions. Act of brooding gives the warmth to chicks till they get stabilized to the environment.

*When artificial brooding is needed:* When broody hens are not available, when natural hatching is not being done, to get laying pullets by own at least cost and large numbers of chicks can be raised.

### a. Brooding arrangement

With a few pieces of equipment and a small place to put them, success in brooding and rearing is virtually assured. During this period of the bird's life, the most important needs are for warmth, protection, feed ,and water. Chick brooders can

be as simple as a cardboard box in the house or garage or bamboo and wood to maintain required body temperature to curb the chick mortality because of cold stress due to improper brooding practices and to protect from predators. In both cases, the most important aspect is to maintain conditions that allow the birds to thrive.

**b. Materials required for brooding arrangement**

*i)* *Brooder Guard:* To protect chicks straying away from heat. It can be made of card board sheet or woven bamboo and arranged in a circular fashion.

*ii)* *Incandescent bulb:* To provide light and warmth of broody hen during artificial brooding. 60 or 40 watts bulb is sufficient to brood 25 chicks

*iii)* *Coal brooding:* Coal/wood can be burnt in a pot to provide warmth to chicks

*iv)* *Litter material:* Saw dust and wood shavings can be spread inside the brooder guard and news paper has to be placed over the litter material.

*v)* *Feeder and Waterer:* one feeder made of halving the bamboo and one waterer made up of used up water bottle or plastic vessel with plate for 25 birds.

**c) Step wise procedure for Brooding**

1. Spread feed on the newspaper for first few days

2. After 3 days, remove newspaper

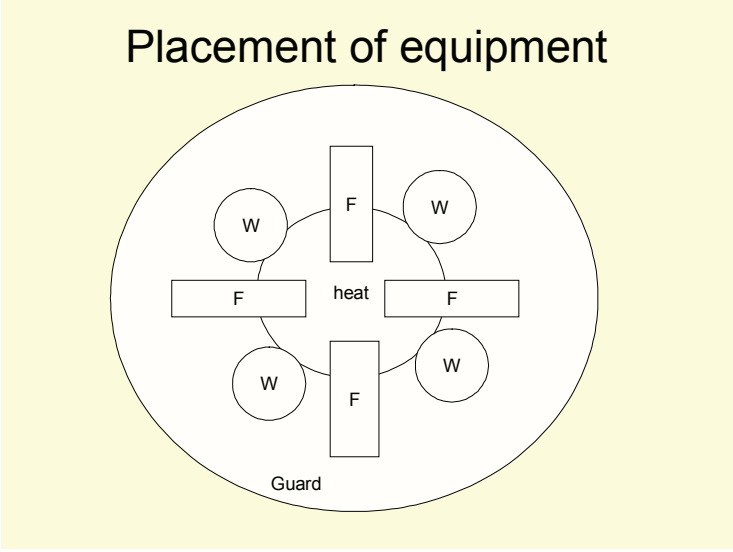
3. Check whether the warmth given is sufficient to the chicks.

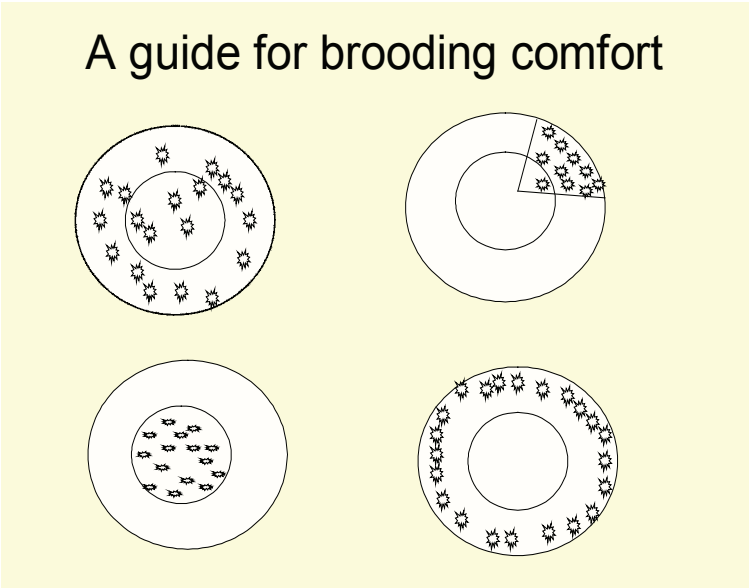
4. Warmth is checked by watching the distribution of the chicks within the brooder guard

5. If chicks are crowded under or near the source of heat – it means warmth is not sufficient and hence heat may be increased

6. If chicks are moved to the periphery and are reluctant to come to the centre under the heat source – it means warmth is high – hence temperature may be decreased

7. If chicks walk freely throughout the brooding area and are uniformly distributed means chicks are comfortable – it




A guide for brooding comfort

## Chapter VI

# FEEDING OF NICOBARI FOWL

### 6.1 Need for Supplemental feeding

a) Feeding is essential to increase the production of meat and eggs from poultry. They are fed only leftovers and feed, they find by scavenging. Lack of feed or water will reduce the birds' resistance to diseases and parasites, and subsequently increase flock mortality.

b) Nicobari birds are normally the best converters of feed to eggs under fluctuating environmental conditions, although their production potential is much lower than genetically improved breeds.

c) By offering supplementary feeds, egg production and growth of Nicobari fowl will be enhanced and performed well.

## 6.2 What to feed?

1. The composition and availability of feeds will vary, depending on the season, site location and farming systems.

2. Poultry need energy and protein, as well as vitamins and minerals.

3. Type of feed will be changed, depending on the age and production status (chicken, grower, egg layer, broody hen) of the bird.

4. The cheapest feed is the use of local resources. However, many vitamins and nutrients are destroyed if stored too long or under sub-optimal conditions, e.g. high humidity and heat.

## 6.3 Types of feed

★ Starters' diet: high in protein; from hatch up to 4 to 6 weeks of age

★ Growers' diet: medium in protein; up to 20 weeks

★ Layers' diet: lower in protein; hens from 20 weeks on wards

Avoid giving commercial feeds to local breeds, as it is not feasible and economical. It will increase the cost of production. Only during the first four to six weeks of age, premixed supplementary feed may be given. Depending on the type of feed, it will contain more or less energy and protein, as well as vitamins and minerals.

### *a. Energy feeds*

1. Normally, at least three fourth of a poultry diet is made of energy feeds.

2. Energy feeds are the most important feeds to maintain body temperature and exercise levels of the birds.

3. Energy feeds are cereals like maize (corn) and its by-products (bran), sorghum (milo), wheat and its by-products (bran, shorts, screenings), rice and its byproducts (bran, polishing), tapioca, sweet potato meal, plantain and banana meal. Roots and tubers should be soaked in water for 60 minutes or cooked before drying to remove harmful substances, and the proportion in the diet in general kept below 1/10.

4. Fat is also a good source of energy Eg: Raw coconut

***b. Protein***

1. Protein is needed for growth and keeping up a good health status.

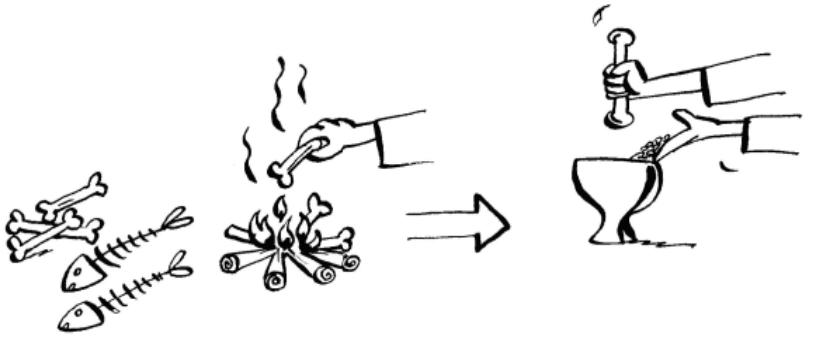
2. 1/5 of a diet is protein-rich feeds

3. Protein may be either animal sources or plants.

4. Commonly used protein sources for rural poultry are Maggots, termite eggs, insects, worms, meat scraps, fish scraps and coconut

**c. Minerals**

Minerals are important for bone formation, eggshell formation and a good health status. The most important minerals are calcium and phosphorous. To produce strong shells for their eggs, laying hens need free access to calcium (lime stone or crushed shells). Phosporus should be balanced with calcium, since too high levels of one may cause deficiency of the other. Sources for minerals are bone meal, crushed oyster shells, snail shells, and burned egg shells.



Eggshells should always be scorched or cooked before re-use in diets to remove any disease germs

**d. Vitamins**: Scavenging birds get vitamins by eating green grass, vegetables, fresh cow dung and through sunlight. Vitamins A, B2, and D3 are important vitamins.

**Low cost balanced feed for Nicobari fowl**

| Ingredients (kg) | Chick | Growers | Layers |
|---|---|---|---|
| Wheat / Broken rice/ Maize | 1 | 1.5 | 1.5 |
| Coconut | 1 | 0.5 | 1 |
| Dry fish | 0.5 | 0.5 | 0.5 |
| Egg Shell/used bone | 0 | 0 | 0.5 |
| Total | | | 3.5 |

**6.4 Simple feed mixing:** Locally available ingredients should be dried in the shade (the sun may destroy important vitamins) and grounded before mixing. One metre trough or a 35 cm (diameter) tube feeder is big enough for 20 adult birds to eat and for 40 to drink. Feeders and drinkers may easily be made out of local materials. Feeders should be filled half full and then checked regularly for refills.

★ Make a small sixed feed for the small chicks from 0-6 weeks of age.

★ Locally available ingredients should be dried in the shade (the sun may destroy important vitamins) and grounded in a mortar before mixing.

★ Locally available containers such as tomato tins or match boxes may be used for easy quantification of the different ingredients. Grams or percentages should be transferred into local quantities for field practice.

★ Above 6 weeks of age, poultry may be fed in a whole grain system saving time and energy on mixing feeds.

★ **Whole grain separate feeding / Cafeteria feeding:** A bamboo pole is split and feed divided into compartments and balanced whole grains are filled in the bamboo feeder. Birds are allowed to take feed ingredients.

**Feed quantity per day per bird**

★ Chicks = 35g

★ Growers = 80g

★ Adults = 100 g

6.5 **Watering:** An empty tin can / bottles should be placed upside down on a plate which may be used as an excellent drinker. By

keeping the tin can upside down, you avoid dirt contaminating the water. Two small holes should be made near the rim of the can / bottle diagonal to each other. Clean water should be poured in the can. The can / bottle should be closed with a flat plate with a small rim on top and the can and plate should be turn upside down, while pressing them against each other. This handmade drinker should be gently placed on the ground. The rim of the plate should be low enough for small birds to drink, but also high enough for adult birds to dip their wattles to keep them cool during hot weather. Feeders and drinkers should always be kept clean to prevent spread of diseases.

## Chapter VII

# NATURAL FEED ADDITIVES FOR NICOBARI FOWL

### 7.1 Azolla: an aquatic fern as potential feed supplement

Azolla is a free floating water fern that floats in water. The most common species is Azolla pinnata which grows naturally

in stagnant water. An Azolla plant floating on the surface of the water is roughly triangular or circular in shape. The stems are covered and hidden by small, alternate, imbricate leaves. Adventitious roots are formed on the lower part of the stem and grow vertically in the water. The more remarkable feature is its symbiotic relationship with nitrogen fixing blue green algae,

Anabaena azollae within leaf cavities. Hence it is considered as a potential bio-fertilizer as it fixes atmospheric nitrogen in association with the nitrogen fixing blue green algae, Anabaena azollae. Due to its higher growth rate, the biomass production is heavy in given time, in recent days, azolla is very much used as a sustainable feed substitute for backyard poultry.

### 7.2 Azolla- A Potential Animal Feed

Azolla contains 25-30 percent protein on dry weight basis. It is rich in essential amino acids, vitamins, growth promoter intermediaries, minerals like calcium, phosphorus, potassium, magnesium and carotenoids including antioxidant B – carotene. The rare combination of high nutritive value and rapid biomass production make Azolla a potential and effective feed substitute for livestock.

### 7.3 Cultivation Technique

It is a simple and low cost technology. It hardly needs any infrastructure. Farmers can cultivate azolla efficiently, economically and easily at their field level itself. Harvesting Yield of Azolla biomass is 1kg / $m^2$. We can harvest 0.5-1.0 kg fresh Azolla daily. A shady place, preferably under a tree with sufficient sunlight should be chosen for the Azolla production unit. A place of direct sunlight should be avoided. All corners of the pit should be of the same level so that the water level the water level can be maintained uniformly.

## Step wise procedure of Azolla cultivation method

| | |
|---|---|
|  A pit of 2 m long and 1 m wide and 20 cm deep is dug under a tree shade |  Lay of silpauline sheet over the pit avoiding any folds and spread 10-15 kgs soil over the soil uniformly |
|  Mix one kg cow dung in 10 litres of water, pour over the soil and add 10-20 g powdered rock phosphate with the cow dung slurry |  Pour water into the pond to a depth of 10 cm and inoculate 05 to 1 kg pure Azolla culture in the pond. In a week, Azolla mass double in quantity. |

### 7.4 Routine Management of Azolla tank

1. Azolla bio mass @ 399 gm. – 350 gm. / sq. mt should be removed daily to avoid overcrowding and for keeping the fern at rapid multiplication

2. After harvesting, the fresh azolla should be washed thoroughly to remove cow dung smell and slit. Washing in a net will be useful as it will allow small plantlets to get out, and they can be poured back in to the pond. The cleaned azolla can be mixed in the feed of poultry.

3. Cow dung @ 10 gm $SuPo_4$ and 500 gm should be added once in a week. Addition of this mixture helps Azolla to multiply rapidly and production of Azolla will be about 1kg per pond per day.

4. Addition of micronutrient mixture weekly will enhance mineral content of Azolla. In summer, shade nets can be used to reduce direct sunlight and light intensity.

5. If pest and disease occurs we can add carbofuran (Furadan 3G granules at the rate of 100 gm per plot). Suitable nutrients should be supplied as and when, nutrient deficiency is noticed

6. About 5 kg. bed soil should be replaced with fresh soil, once in 30 days to avoid nitrogen build up and prevent micro nutrient deficiency.

7. 25 to 30% water also needs to be replaced with fresh water once in 10 days to prevent nitrogen build up in the bed.

8. Replacement of water and soil should be followed by fresh inoculation of Azolla at least once in six months

9. A fresh bed has to be prepared and inoculated with pure culture of Azolla when contaminated by pest and diseases.

### 7.5 Feeding of Azolla for Poultry

Azolla can be fed either as fresh or dry biomass to poultry. Fresh Azolla can be fed @ 200 gm /day/bird. In layers azolla feeding will improve both egg production and its nutritional quality. The increase in productivity, nutritional value, disease resistance and savings in the concentrate feed makes azolla a potential feed supplement for poultry.


### 7.6 Morinda citrifolia as water supplement

The growth performances ability of the *Morinda citrifolia* fruit was tested in Nicobari fowl. Water supplementation of ***M.citrifolia* fruit juice @ 1.5ml / bird / day** improved the egg production by 6.6 per cent. Despite nutritional superiority of egg, there is scare of egg yolk cholesterol; though no significant correlation between egg yolk cholesterol & serum cholesterol. Designer egg concept emerged in an attempt to reduce egg yolk cholesterol and to exploit products beyond their traditional food value and enrichment of either egg or meat retaining their nutritional, functional and sensory qualities. Recent trend in the area of designer poultry products is enrichment with immune enhancing active principles through herbs. Fresh juice of *M.citrifolia* has been scientifically validated for anti-cholesterol properties so that herbal enrichment of eggs has become feasible at farmers' level. The supplementation of morinda juice @ 5% for a period of six weeks recorded the

serum cholesterol of 201 mg/dl while it was 233 mg/dl without supplementation. Hence, *M.citrifolia* could be an excellent feed additive to produce low cholesterol chicken eggs.

## Chapter VIII

# MINI INCUBATOR IN FARMING OF NICOBARI FOWL

### 8.1 Natural Hatching

Natural hatching is the behavior of hen "sitting on" her eggs in order to conceal, warm and hatch them by the warmth of her body.

### Disadvantages of natural hatching

1. When hens go broody, they will stop laying eggs and we can harvest only minimal eggs.

2. Less hatchability

A shift from natural hatching to artificial hatching of chicks at backyard level to maximize the number of edible eggs for household consumption and to improve the hatchability.

### 8.2 Artificial hatching

Hatching is done through a machine called **"Incubator"** which provides optimal temperature and humidity to hatch out chicks. Chickens take 21 days for eggs to hatch.

### a. Mini incubator

This equipment holds just about 100 to 500 eggs at a time. Usually all in all out system where the machine is loaded with one batch and can be reloaded only after the hatch of loaded batch.

**b. Advantage of mini incubator**

★ Comparatively good number of desi chicks by economically viable mini incubator as compared to natural hatching

★ Farmers will have self dependency by having their own desi chicks at regular interval continuously.

★ Availability of good number of eggs for household consumption to farmers due to absence of broodiness in artificial hatching with mini incubator

**c. Key points in operation of mini incubator**

**i. Care of hatching eggs:**

a) Eggs should be fresh before incubation. The age of eggs should not be more than 10 days, when stored at temperatures below 20º C.

b) At field level, the eggs should not be more than 5 days old.

c) The eggs selected for incubation should be of average size and normal shape for the breed.

d) The eggs should have a smooth un-cracked shell.

e) Store the eggs in a cool and humid place until incubation, for example in a box with a hole in the floor of the coolest part of the house.

f) Wash the eggs with sanitizers after collection.

**ii. Sanitation of incubator**

The best sanitation method is by fumigation with formaldehyde gas to kill bacterial organisms inside the incubator.

**iii. Fumigation method:**

a) Measure the inside volume of the machine in cubic feet

b) Close the ventilators with the fans on

c) Weigh the required amount of potassium permanganate in to a wide earthenware vessel and place inside the machine and add the formalin

d) Close the door immediately and leave closed for 20 minutes

e) After 20 minutes, open the ventilators

**iv.** **For preventive measure**: Mix 40 ml of formalin with 20 g potassium permanganate in a mud plate and keep inside the incubator for 20 minutes

**v.** **During disease outbreak**: Mix 80 ml of formalin with 40 g potassium permanganate

a) Fumigate the incubator after the chicks have been removed and prior to discarding the refuse from the tray

b) Again fumigate the incubator after thorough cleaning

c) After every hatch, all trays used for hatching should be thoroughly cleaned and dried under sunlight and fumigated.

### d. Steps in incubator operation

1. Collect hatching eggs (2 times day)
2. Segregate eggs that are not suitable for hatching
3. Clean soiled eggs with sanitizer or dry cleaning
4. Storage for 2-7 days at refrigerated temperature
5. Fumigate machine (60 g potassium permanganate + 120 ml of formalin for 100 $ft^3$) for 20 minutes
6. While setting eggs, remove eggs from refrigeration and allow it to sweat and dry
7. Fumigation (40 g potassium permanganate + 80 ml of formalin) for 20 minutes immediately after setting
8. Candling on $18^{th}$ day of incubation to remove infertile eggs
9. Shift eggs into egg flat on $18^{th}$ day
10. Take out chicks on 21-22 days
11. Remove of hatch waste and fumigate at 5X concentration (100 g potassium permanganate + 200 ml formalin) for 3 minutes and clean the machine
12. Give a gap for 2-3 days for reloading the machine

**Physical requirements in incubator**

| Requirements | 1-18 days | 19-21/22 days |
|---|---|---|
| Temperature | 100.5$^0$F (37.8$^0$C) | 99.5$^0$F (37.2$^0$C) |
| Humidity | 55 to 58 % | 65 to 70 % |

### e. Candling

Eggs are checked whether they are fertile and non-fertile. Fertile eggs very quickly develop blood vessels, which may be seen against a sharp light from a torch. After 18 days of incubation the eggs can be candled. While candling, a fertile egg has visible blood vessels and a dark spot that is the embryo. If the embryo is dead, it is seen as a ring of blood around the embryo. Infertile eggs and eggs with dead embryos must be removed as they will decompose and may break and spoil the fresh eggs under incubation.

### Home-made candler

*Infertile egg*
*Fertile eggs*

## f. Reasons for poor hatchability

1. Infertile eggs

2. Eggs too old when set

3. Parent stock fed on nutritionally deficient diet

4. Improper care of eggs prior to incubation & Shell contamination

5. Improper turning of eggs, variable

6. Temperature & humidity during incubation & Improper ventilation

7. Oxygen starvation

8. Unhealthy and weak parents

## Chapter IX

# COMMON DISEASES IN RURAL POULTRY IN A&N ISLANDS AND ITS MANAGEMENT

**Healthy and unhealthy birds:** It is very important for the farmer to learn how to detect an unhealthy or sick bird, Healthy birds may be able to fight against the diseases themselves whereas unhealthy birds will have difficulties in fighting diseases. It is important to isolate unhealthy or sick birds from the healthy flock in order to ensure a minimum of loss.

*Prevention of diseases***:** Diseases are everywhere and will attack birds at all ages, but careful management will prevent many diseases. Clean and nicely keep outside and inside of house. Clean water from a well, not a pond, is important to avoid the spread of waterborne diseases, such as Fowl Cholera and Avian Influenza (AI).

### 9.1 Important diseases

*Newcastle Disease***:** The disease is very common during dry seasons, and is often seen in young chicks, but also in adults. High flock mortality, often between 30% and 80% of the birds die, when the disease hits.

Signs include loss of appetite, Heavy breathing, Greenish droppings/ sometimes bloody diarrhoea, nervous symptoms, paralysis and die suddenly. The disease is a virus, so there is no treatment. Prevention is by vaccination of all birds from two weeks of age.

*Marek's Disease:* It is a deadly and common viral Condition. Due to its hardiness, it can survive the harshest of conditions. Paralyzed legs, wings, and/or necks, Diarrhea, weight loss, and difficulty in breathing are the symptoms. Prevention is to vaccinate the birds. Always check to make sure chickens are vaccinated for this disease before buying them.

*Fowl Pox:* A Common Backyard Chicken Disease. It is transmitted by pecking at insects on the skin or fighting. Recovery is its own. Keep houses/shelter clean as a preventive measure.

*Pullorum disease (Bacillary white diarrhoea):* It affects young chicks. Walk with difficulty,Big bellies and dragging wings,Faeces is liquid and turns white are the signs. There is no treatment. Strict hygiene, Isolate or kill and burn the birds are preventive measures.

*Gumboro (Infectious Bursal Disease, IBD):* Chicks younger than 6 weeks are commonly affected. Common symptom is diarrhoea. There is no treatment. Vaccination is the preventive measure.

*Chronic respiratory disease (Mycoplasmosis):* Symptoms are runny or blocked nose, swollen face, and closed eyes, drop in egg production and rare deaths. Supplementation of antibiotics in drinking water is the only treatment.

**Internal parasites**

*Coccidiosis* **:** It occurs in all ages. Signs are tired, head down, ruffled feathers, bloody diarrhoea. Death in young chicks. If the chicks survive, they will remain thin and be late in laying. Treatment includes Anti-coccidiostatics in drinking water or feed. Regular and careful cleaning of troughs and poultry houses is the preventive measure.

*Worms***:** Backyard Chickens can get internal parasite quite often. It is more dangerous to their health than external parasites. A pale comb, Diarrhea and Weight loss are the symptoms. Prevention include clean up their feaces in order to prevent spreading them to others in the flock. Do not eat any eggs that your chickens produce when they have worms.

## External Parasites

*Fleas, Ticks, Lice, and Mites:* External parasites are very common among backyard chickens. Chicken lice looks similar to the head lice seen on the heads of young human children. These are easy to see crawling over the feathers or burrowed into the skin. These parasites are annoying to chicken, and cause serious medical conditions like tick fever. At the very least they can cause itching and skin irritation, which can leave chickens open for other infections. Treat mild infestations quickly.

## Chapter X

# BIO-SECURITY MEASURES FOR NICOBARI FOWL

### What is bio-security?

Bio-security means protecting live organism from pathogenic microorganism including virus, bacteria, fungus and parasites.

### 10.1 Why bio-security for rural poultry?

Rural poultry are the primary and cheap source of animal protein among the rural farming community. Backyard poultry production is practised in most rural and peri-urban areas of the world and is mainly based on the rearing of native poultry breeds. Acute heavy mortality is ever increasing menace among rural poultry. Diseases could attack birds at all ages and it is much easier among rural poultry as they are let all the time freely. Outbreak of disease in an area is quickly spread to the birds of other places as they are all at free range always together.

On exposure to infected birds, healthy birds may be able to fight against the diseases to some extent whereas unhealthy birds will have difficulties in fighting diseases and succumb to diseases very quickly. However, appropriate management will prevent the occurrence of many diseases as prevention is better than cure.

### 10.2 Preventive measures

★ Shelter for rural poultry: Elevated Housing of one ft from ground level will prevent rural poultry from direct contact

with their feacal material and them from exposure to water logging.

★ Clean and nicely keep outside and inside of house.

★ Supplementary feeding, in particular for small chicks, is one of the most important means of preventing diseases.

★ Clean water from a well, not a pond, is important to avoid the spread of waterborne diseases.

★ Mix a pinch of bleaching powder in a bucket full of water and keep it overnight. Provide that water for birds next day.

★ It is important to isolate unhealthy or sick birds from the healthy flock in order to prevent the transmission of diseases from sick to healthy birds.

★ Sprinkle lime powder at least once in a week around the house.

★ Fumigate the house once in two months with potassium permanganate (20 gm) and formaldehyde (40 ml).

★ During the common problem of eye infection of desi birds, mix a pinch of potassium permanganate in water or boil turmeric powder and wash the eye discharge with those solutions.

★ Soak crushed neem leaves in water whole night and filter it and provide that neem extract to the chicks immediately after hatch.

★ In case of serious diseases slaughter the bird. If you do not kill it the bird at once, it must be separated from the others.

★ Sick birds (or parts from sick birds) should be burned or buried deep enough to avoid that dogs and other animals dig them up and spread the disease.

★ If there are many sick animals/birds, new birds should not be introduced and do not be vaccinated.

★ Vaccinate all birds against Newcastle Disease and other prevailing diseases on a regular basis to prevent high mortality. Small chicks should be vaccinated against the common contagious diseases at the age of 2-3 weeks.

★ Revaccination should always be performed.

### 10.3 Vaccination

Vaccination is an effective means to prevent the adverse effects of specific diseases in poultry. Disease-causing organisms can be classified as viruses, mycoplasma, bacteria, fungi, protozoa, and parasites. All these organisms except viruses are susceptible to chemotherapy. Control of viral diseases is dependent upon prevention through vaccination.

**Vaccination schedule for Nicobari fowl/desi birds/vanaraja birds**

| Age | Name of Vaccine | Dose | Route of Vaccination |
|---|---|---|---|
| 5-7$^{th}$ day | RDVF | 1-2 drops | Intra nasal/intra ocular |
| 14-16$^{th}$ day | IBD | 1-2 drops | Intra ocular |
| 24-26$^{th}$ day | Lasota | -- | Drinking water |
| 4$^{th}$ week | IBD booster | 1-2 drops | Intra ocular |

| | | | |
|---|---|---|---|
| 7th week | Deworming | | |
| 8th week | R2B | 0.5 ml | Intra muscular or Subcutaneous |
| 16th week | Lasota | | Drinking water |
| 18th week | R2B | | Intra muscular or Subcutaneous |
| Lasota once in 2 months in drinking water | | | |

**Vaccination schedule for broilers**

| Age (Days) | Diseases | Route of Vaccination |
|---|---|---|
| Day old | Infectious Bronchitis Newcastle Disease | Eyedrop or course spray (Usually done at hatchery) |
| Day 14 | Infectious Bursal Disease (Gumboro) | Drinking water |
| Day 16 - 18 | Newcastle Disease | Drinking Water |
| Day 18 | Infectious Bursal Disease | Drinking Water |
| Day 28 | Newcastle Disease (Lasota type) (Only if birds kept longer than 42 days) | Fine spray (Atomist or other) |

### 10.4 Precautions while vaccination

★ An outdated vaccine may have deteriorated.

★ Each vaccine is designed for a specific route of administration. Use only the recommended route.

★ Do not vaccinate sick birds

★ Protect vaccines from heat and direct sunlight.

★ Most vaccines are living, disease-producing agents. Handle them with care.

- ★ When using the drinking-water method of vaccination, be sure the water is free of sanitizers and chlorine. Live-virus vaccines are readily destroyed by these chemicals.
- ★ After vaccinating, all opened containers should be burned or disinfected to prevent accidental spread to other poultry.
- ★ All vaccines should be checked for label of instructions for use and dates of expiration.

## Chapter XI

# ETHNO VETERINARY MEDICINAL PRACTICES FOR HEALTH MANAGEMENT OF NICOBARI FOWL

Medicinal plants are an integral component of Ethno - Medicine. Andaman & Nicobar Island, the hotspot of biodiversity represents a great emporium of ethno botanicals wealth. The agro-climatic condition of Andaman and Nicobar Islands is very much congenial for the cultivation of Medicinal Plants. More than 300 Medicinal and Aromatics Plants are indigenous to these Islands. The use of traditional medicine and medicinal plants in these islands as a normative basis for the maintenance of good health has been widely observed in tribal herbal remedies.

Herbal health management with ethno-veterinary medicinal plants have been done for Nicobari fowl and few ethno veterinary practices for poultry have been documented in pristine Andaman Islands.

### 1.1. *Morinda Citrifolia*

It is commonly known as Noni, belonging to the family Rubiaceae, grows widely throughout the coastal regions of many countries including the Andaman & Nicobar group of Islands, India. It is also called Indian mulberry, Ba Ji Tian, Nono or Nonu, Cheese fruit and Nhau in various countries throughout the world. In these Islands it is commonly known as Lorang, Burmaphal, Pongee phal and Surangi by the tribal. *Morinda citrifolia* has a rich history in India, where it has been used for tens of centuries in the system of medicine known as Ayurveda. This small evergreen tree (10-20ft) is native to India and also

distributed to southeastern Asia to Australia and now has tropical distribution widely adapted to the tropics. It can grow in challenged environments viz., saline, acidic and alkaline soils. In Andman & Nicobar Islands, the plant is mainly found in the Nicobar goup of islands and is one of the most significant shrubs of traditional medicines among Nicobari tribes of these Islands.

*Morinda citrifolia* L., the "noni", has been used in traditional Polynesian medicine for over 2000 years. *Morinda citrifolia* (Rubiaceae) is an evergreen shrub whose ripe fruit has a strong butyric acid smell and flavor. The leaves and especially the fruit are consumed in different forms by various communities (e.g., the Polynesians) throughout the world; the root is used as a dye.

It has been reported to have a broad range of therapeutic effects in the traditional medicines and alternative medicines having broad range of therapeutic properties such as antibacterial, antiviral, antifungal, antitumor, antihelminth, analgesic, hypotensive, anti-inflammatory, and immune enhancing effects. The fruit of *Morinda citrifolia* is a powerful Detoxifier. It removes the toxins from cells of our body. It builds and strengthens every cell of our body to stay healthy. Researchers have discovered more than 200 Neutraceuticals in the fruit of *Morinda citrifolia*. The roots, stem, bark, leaves, flowers and fruits of the Noni plant are all involved in various combination of herbal medicines.

**a. Antimicrobial activity of *M.citrifolia***

Fruit, leaf and stem bark of the *M.citrifolia* L. possess antibacterial and antifungal activity and the extraction of

these compounds may be useful against treatment of different bacterial and fungal infection. The best antibacterial and antifungal activity was found in the ethanol extract. Ethanol may be used for extraction of antimicrobial compounds. The broad range of antimicrobial activity of *M.citrifolia* L. May be exploited in detail as these plants are available in plenty and the activity may be useful in identification of some novel antimicrobial compounds from this plant. Though the *Morinda citrifolia* L. Is having wide range of health stimulating properties, it needs much more research to establish its scientific authenticity for the proclaimed healing properties. The need of the hour is to identify the active compound, its isolation and understanding its mode of action.

### b. *M.citrifolia* as Immunomodulator in Nicobari fowl

Effect of feeding of *Morinda citrifolia* fruit juice on immune response of Nicobari Fowl was conducted. Fresh *Morinda citrifolia* fruit juice was given @ 1.5ml/bird/day to Nicobari fowl and compared with control gropus. The humoral immune response revealed the appearance of antibody in all the groups at first week of post immunization of goat RBC. The *in-vivo* cell mediated immune response to PHA-P (Phytohaemagglutinin) was observed more (2.8±0.02) morinda fed birds than in control (1.37±0.18). Based on the finding of the present study it is concluded that Water supplementation of *M.citrifolia* fruit juice @ 1.5ml / bird / day enhanced immunity by 26% in Nicobari fowl. Similar study has been taken up in Japanese quails. M.citrifolia fruit juice @ 5% in water improved immunity by 21% in Japanese quails. *M.citrifolia* **is found to elicit good humoral and cellular response and thence** immunomodulator effects **in**

**Nicobari fowl.** The nutrient richness of this plant is very useful as a mineral and vitamin supplement in poultry.

### c. Synergistic effect of *Morinda citrifolia* fruit juice and *Lactobacillus acidophilus*

The study on synergistic effect of *Morinda citrifolia* fruit juice and *Lactobacillus acidophilus* by supplementing 2.5 ml noni + 2.5 ml LAB/bird/day in broiler has reported that humoral immune response in noni+LAB group (0.73) was found to be significantly higher than control group (0.36) and other individual noni and lactobacillus groups (0.53) at one week post inoculation of GRBC. Noni and LAB combination showed significant ($P<0.05$) reduction in the coliform load.

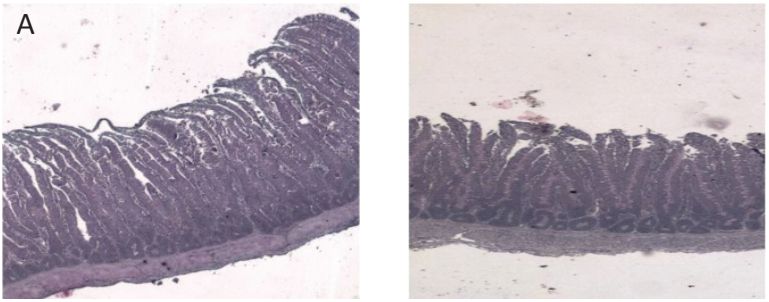
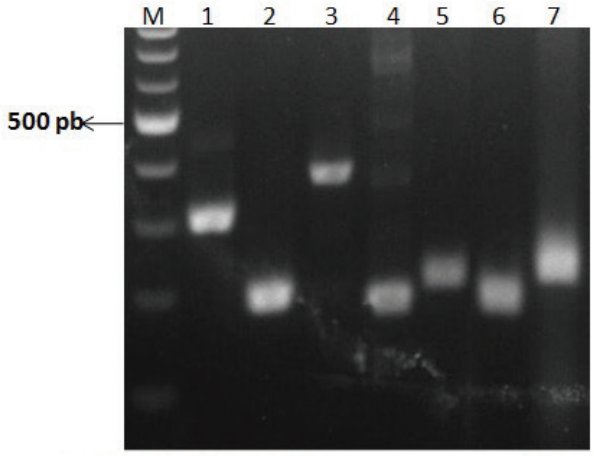



Fig : Villi height and crypt depth of the duodenum of broiler fed with diet containing noni+LAB ( A- Morinda group, B- control)

Hence, the combination of noni and LAB might be promising alternatives for antibiotic growth promoters to improve the production of safety poultry products. Studies on *Morinda citrifolia* juice and *Lactobacillus* combination is the first report which showed the beneficial properties of the combination of *Morinda citrifolia* and lactobacillus.

### d. Immunomodulatory effect of *Morinda citrifolia* and *Andrographis paniculata* on Expression of Toll-Like Receptors

Toll Like Receptors (TLR) are innate immune receptors and induce fast and appropriate host defence reaction against pathogens. The present experiment was conducted to study the effects of dietary supplementation of Noni and kalmegh on expression of Toll-like receptors in Nicobari fowl. Nicobari fowl




Lane M : 100 DNA ladder
Lane 1: TLR2
Lane 2 : TLR3
Lane 3: TLR4
Lane 4 : TLR5
Lane 5 : TLR7
Lane 6 : TLR15
Lane 7 : TLR21

**Plate : Amplification of different TLRs of Nicobari fowl Ceacal tonsil sample by RT-PCR**

is an indigenous poultry breed available in A & N Islands. A total of 120 day old Nicobari chicks were divided into five groups in a completely randomized design with four replicates of 6 birds in each replicate. Birds were randomly assigned to each of four dietary supplements namely: T1 – 10 ml noni juice + 200

mg Kalmegh powder per bird per day; T2 – 15 ml noni + 400 mg Kalmegh powder per bird per day; T3 – commercial tonic 4 ml/bird/day; T4 – 10 ml noni juice + 200 mg Kalmegh powder per bird on alternate days and T5 – control ( no tonic). To assess expression of Toll-like receptors, cecal tonsils were collected from both sides of the ileocecal junction at the age of 21 days. Total RNA was isolated using Rneasy kit and expression was quantified with Real-Time PCR (QPCR) using SYBR Green using Mx 3000P spectroflurometric thermocycler. Results revealed that supplementation of Noni and Kalmegh significantly influenced the gene expression levels of TLR-2, TLR-3, TLR-4, TLR-5, TLR-15 and TLR-21 as compared to control. The T2 group significantly increased the expression of TLR-5 where as T1 significantly increased the expression of TLR-4 as compared to control and commercial tonic groups. There was no significant increase in the expression of TLR-4 with commercial tonic as compared to control and the expression levels of TLR-2 & 3 with T1, T2 and T4 were on par with the commercial tonics. The selectively increased TLR-3, TLR-4 and TLR-5 and decreased expression of TLR-7 indicated that supplementing Noni fruit and kalmegh (@ 10 ml + 200 mg per day per bird) induces antiviral and antibacterial responses in chicken. In conclusion, Noni and kalmegh might be promising alternatives for antibiotic growth promoters and commercial immune boosters to improve the production of safety poultry produce.

### *f. Morinda citrifolia* and Kalmegh (*Andrographis paniculata* Nees) on growth, production and immunity in Nicobari fowl

A total of 125 day old Nicobar chicks were selected for the present studies. The birds were equally divided into 5

groups with 25 birds in each group. The birds were provided with standard feeding and mangagemental practices. The experiment was conducted with the following treatment.

| | |
|---|---|
| T1 | 10 ml *Morinda citrifolia*juice + 200 mg Kalmegh powder per bird per day |
| T2 | 15 ml *Morinda citrifolia*+ 400 mg Kalmegh powder per bird per day |
| T3 | Commercial tonic 4 ml/bird/day |
| T4 | Control ( no tonic) |
| T5 | Alternate days: 10 ml *Morinda citrifolia*+ 200 mg Kalmegh powder per bird per day |

The parameters viz growth, body weight gain, mortality and immune response were recorded and calculated.

**Growth and egg production performance:** The T1 group showed highest body weight gain after the feeding of Morinda and Kalmegh. All the treatment groups showed similar trend in term of body weight gain after the feeding of Morinda and Kalmegh as compared to control. Body weight gain at age of sexual maturity was found to be better in T3 followed by T1, T2 & T5 respectively. No significant difference was obtained with the alternate feeding of Morinda and Kalmegh compared to the other groups of Morinda and Kalmegh. No significant difference was obtained in terms of egg production both for hen day egg production and hen housed egg production. However, the treatment group showed better production than the control group. So based on the growth performance it is inferred that the feeding of *Morinda citrifolia* @ 10 ml per day + 200 mg Kalmegh on alternate days in the Nicobari fowl showed better body weight gain and egg production compared to the commercial tonic.

**Table : Growth performance and egg production performance**

| Treatments | Weight gain after treatment at 16 weeks | Weight gain at ASM | HDEP % NS |
|---|---|---|---|
| **T1** | 253.00$^{a}$±12.67 | 208.90$^{b}$ ±17.06 | 33.11 ±2.77 |
| **T2** | 238.43$^{a}$ ±20.04 | 189.53$^{b}$ ±20.15 | 31.64 ±2.45 |
| **T3** | 233.53$^{a}$ ±26.78 | 240.41$^{a}$ ±27.18 | 33.75 ±2.25 |
| **T4** | 180.54$^{b}$ ±35.05 | 138.20$^{c}$ ±26.34 | 31.17 ±2.26 |
| **T5** | 247.36 $^{a}$ ±21.06 | 198.64$^{b}$ ±32.67 | 32.38 ±3.15 |

ASM: Age at sexual maturity; HDEP: Hen day egg production; HHEP: Hen housed egg production

**Feed efficiency:** Feed efficiency with respect to the body weight gain was found to be significantly better ($p<0.05$) in T1 followed by T2, T5, T3 and T4 respectively. The control group showed least feed efficiency compared to other groups. However, at the time of puberty the feed efficiency was found to be high with growiplex compared to other groups.

**Table: Feed efficiency of Kalmegh and Morinda feedin**

| Treatments | Feed efficiency for weight gain after treatment at 16 weeks | Feed efficiency at ASM |
|---|---|---|
| T1 | 6.16$^{a}$±2.67 | 7.29$^{b}$ ±7.06 |
| T2 | 6.47$^{a}$ ±0.04 | 6.98$^{b}$ ±2.15 |
| T3 | 7.24$^{b}$ ±6.78 | 7.46$^{a}$ ±7.18 |
| T4 | 7.66$^{c}$ ±5.05 | 7.87$^{c}$ ±6.34 |
| T5 | 6.51$^{a}$ ±2.06 | 7.43$^{b}$ ±3.67 |

**Immune response:**Effect of feeding of Morinda and Kalmegh was evaluated for humoral immune response and cell mediated immune response. The humoral immune response was studied by conducting haemagglutination test with Goat RBC (GRBC) while cell mediated immune response was studied by injecting phytohaemagglutinin- P in foot pad of the birds. The result of the humoral immune response showed that the feeding of Morinda and Kalmegh enhanced the B cell immunity and is at par with the commercial tonic. In all the groups the immune response was found to be high compared to control. Similar trend with obtained with the cell mediated immune response. The immune response increased with the increase in dose of the Morinda and Kalmegh. Based on the immune response, it is inferred that the feeding of Morinda and Kalmegh with alternate day is sufficient to boost the immunity and may be used as a replacement to the commercial tonic.

**Table : HA titre value at different days of post immunisatio**

| Treatments | 7th day | 14th day | 21st day |
|---|---|---|---|
| T1 | $1.33^{a}$±0.07 | $0.90^{a}$ ±0.06 | $0.84^{a}$ ±0.02 |
| T2 | $1.50^{a}$ ±0.04 | $0.99^{a}$ ±0.15 | $0.89^{a}$ ±0.07 |
| T3 | $1.53^{a}$ ±0.07 | $1.03^{a}$ ±0.08 | $0.98^{a}$ ±0.05 |
| T4 | $1.09^{b}$ ±0.05 | $0.48^{b}$ ±0.08 | $0.33^{b}$±0.03 |
| T5 | $1.36^{a}$ ±0.06 | $0.93^{a}$ ±0.10 | $0.86^{a}$ ±0.09 |

**Table : Cell mediated immune response in chicken**

| Treatments | Foot pad thickness (mm) |
|---|---|
| T1 | $0.84^{a}$±0.17 |
| T2 | $0.88^{a}$±0.12 |
| T3 | $1.00^{a}$±0.15 |
| T4 | $0.39^{b}$±0.08 |
| T5 | $0.96^{a}$±0.14 |

### 11. 2 Kalmegh (*Andrographis paniculata Nees)* feeding in Nicobari fowl as immune enhancer

*Andrographis paniculata* (AP) a promising medicinal plant commonly used in humans as an immune system booster. Main Bioactive compounds are Andrographolide and diterpenoid lactone. It has been scientifically validated to inhibit lipid peroxidation and free radical activities. Herbal feed additives as an alternative to antibiotic growth promoters have been indicated to exert immunomodulatory action; which confer birds with greater general immunity from various diseases. In view of the above facts, the present investigation was undertaken to study the efficacy of kalmegh powder as feed additive on the immunity and performance of Nicobari birds. Sixty Nicobari fowls chicks belonging to same batch were managed under deep litter system standard management. All birds were fed *ad libitum* feed as per Bureau of Indian Standards (BIS, 2007) recommendation. Thirty chicks were assigned to each of following two dietary treatments with three replicates of 10 birds in each replicate; $T_1$: Breeder diet supplemented with Kalmegh powder at the rate of 1 g per bird per day; $T_2$: Control diet with out Kalmegh supplement. Experimental feed was fed till sexual maturity. The growing performance was evaluated throughout

the experimental period. Experiment on any herbal feeding is required to analyse its effect on growth performance and feed intake; since any supplementation as immune enhancer should not hamper the feed intake and production performance.

**Table: Effect of Kalmegh feeding on growth performanc**

| Treatments | Body weight (g)/Age in months | | | |
|---|---|---|---|---|
| | 2 NS | 3 NS | 4 NS | Age at sexual maturity NS |
| 1 g / bird/day | 303.5 ± 10.25 | 583.5 ± 25.66 | 1094 ± 45.60 | 1198.9 ± 51.33 |
| Control | 313.2 ± 20.09 | 530.0 ± 25.71 | 1191.6 ± 44.98 | 1188.8 ± 98.98 |

**NS - Nonsignificant**

The supplementation of Kalmegh did not reduce the growth rate of treated groups. The adult body weight of control group is at par with the Kalmegh supplemented groups. The result revealed that Kalmegh reduced neither feed intake nor impaired growth.

### i. Kalmegh feeding in breeding fowls

Two hundred seventy breeding Nicobari fowls belonging to same batch were selected at 35 weeks of age. Optimal male female ratio was maintained. Birds were managed under deep litter system and 16 hours light with 3 lux of intensity per sqft. All birds were fed *ad libitum* feed as per Bureau of Indian Standards (BIS, 2007) recommendation. Thirty six breeders were assigned to each of following dietary treatments in a completely randomized design with three replicates of 30 birds in each replicate; T1: Breeder diet supplemented with Kalmegh powder at the rate of 1 g per bird per day; T2:

Breeder diet supplemented with Kalmegh powder at the rate of 1 g per bird per day. T3: Control diet with out Kalmegh supplement. Experimental feed was fed for a period of 60 days. The laying performance was evaluated throughout the experimental period. At 15$^{th}$ day of feeding, humoral immunity of breeders was assessed through haemagglutination test (HAT) using goat red blood cells (GRBC) as an antigen as per the method described by Siegel and Gross (1980). The titer was expressed as the log2. Chicks were hatched out from experimental birds. The duodenal morphology of progeny from experimental birds was measured at the age of eight weeks and their immunity was assessed at 12 and 16 weeks of age. Chicks were slaughtered by humane method at the age of 8 weeks. Duodenal tissue samples were carefully cleansed and fixed in 4% buffered formalin for two days. Tissue was processed through dehydration in Phosphate Buffer Saline and graded ethanol solutions, clearing with xylene and embedding in paraffin. Tissue samples were deparaffinised, rehydrated and stained with hematoxiline-eosine according to the method described by Bancroft and Marilyn (2008). Sections of 5 µm were prepared and placed on glass slides.The villi heights and crypt depth of duodenam was examined by photomicroscope. A total of 12 intact well-oriented villus-crypt units were randomly selected at each tissue sample. Villus height was measured from the tip of the villus to the villus-crypt junction and crypt depth was measured as the extent of invagination between two villi. Statistical analysis of measurements was carried as per Snedecor and Cochran (1994). The significance of the difference among the groups was determined by Duncan's multiple range tests (Petrie and Watson, 1991).

Laying performance of birds such as egg production, egg weight and egg mass, feed consumption, feed efficiency and hatchability was not hampered due to Kalmegh supplementation. Further, improved feed efficiency was recorded with Kalmegh feed additive. Active principles such as Andrographolides responsible for nutrients digestion and absorption present in Kalmegh and might have attributed to improved feed efficiency for egg mass production in Kalmegh groups

**Table: Effect of Kalmegh feeding on Laying performance of breeders**

| Laying parameters | 1 g / bird/day | 3 g/bird/day | Control |
|---|---|---|---|
| Age at sexual maturity | 23 weeks | 22 weeks | 25 weeks |
| HDEP% | 42.92 ± 1.41 | 45.33 ± 2.16 | 40.00 ± 4.39 |
| Egg weight (g) | 42.2 ± 0.31 | 43.33 ± 2.16 | 41.4 ± 0.29 |
| Egg mass (g/hen/day) | 18.1 ± 0.81 | 19.35 ± 2.31 | 16.4 ± 3.61 |
| Feed consumption (g) / bird / day | 108.18 ± 1.40 | 110.1 ± 3.65 | 111.8 ± 14.53 |
| Feed efficiency per g egg mass | 5.96 ± 1.21 | 5.68 ± 3.11 | 6.82 ± 2.21 |
| Hatchability % | 69.73 ± 5.23 | 71.03 ± 7.61 | 69.98± 8.59 |

## ii. Effect of Kalmegh in breeder feeding on immunity and duodenal morphology of progeny

A highly significant difference was recorded in the HA titre of breeder fowls treated with Kalmegh powder of 3 g (1.81) and 1 g (1.51) as compared to control group (1.2) on 1st week post inoculation of Goat RBC and the immune response was found to be sustained till 3rd week with 3 g. The progeny of breeders fed with 3 g of Kalmegh, showed a significantly higher HA titre at the age of 12 weeks (0.55) and 16 weeks (0.38); this higher humoral response was recorded till 3rd week of inoculation as compared to control. Significant microscopical changes occurred in crypt depth and villi height at the level of duodenum in layers of the intestinal wall of progeny from breeders fed with Kalmegh feed additive. The villi height (µm) and crypt depth (µm) varied significantly and were better in the progeny of breeders fed with Kalmegh than the progeny from control group. The control group mucosa contained villi with a height of approximately 269.28 ± 18.48 that was significantly lower than the 1 g (323.11 ± 16.48) and 3 g (365.06 ± 16.0). The crypt depth of progeny from 3 g (54.42 ± 4.8) and 1 g (58.15± 3.42) were significantly lower than the progeny of control group (63.79 ± 1.72). Intestinal glands attached to the villi of control chicks consisted of a small lumen and epithelium as well as a small number of leukocytes. Lax connective tissue from the villi and interglandular corrion connect both the lymphatic and capillary network and was loaded with many infiltrate cells. The capillary network showed evidence of hyperplasia and hypertrophy; where as the chicks from Kalmegh fed breeders had a villi with intestinal glands of the duodenum having a large lumen and were surrounded by thin interglandular spaces, with the interglandular villi containing collagen fibres, fibroblasts

and leukocytes infiltrate. A large number of leukocytes were in transit between the glandular epithelial and villi. The interior muscular layer, made up of circular muscle fibres in the endomysium and perimysium capillary ectasia and leukocytes infiltrates were recorded. The arteries, veins and capillaries present in external perimysium contained large lumens. These images through the duodenum suggest that the angiogenesis process has been stimulated judging by the presence of the capillary ectasia in the main villi and interglandular villi.The results of duodenal morphometry of 8 weeks old progeny of breeders treated with 3 g Kalmegh showed the lowest crypt depth (54 µm) and highest villi height (365 µm) as compared to control (63 µm & 269 µm respectively). The higher villi height indicated the increased surface area for more nutritional absorption and the lower crypt depth for favorable microbial environment of intestine in the progeny of treated breeders. The significant efficacy of *Kalmegh feed additive* was evident at the duodenal morphology which is primary site for the development of immune response and where nutrient uptake takes place. Based on this study, it is inferred that Kalmegh feed additive at the rate of 3 g per bird per day for breeder fowl improves the immunity and gut health of progeny.

**Table: HA titre of Nicobari breeding fowl at various intervals**

| Treatments | 0 day | 7$^{th}$ day | 14$^{th}$ day | 21$^{st}$ day |
|---|---|---|---|---|
| 1 g / bird/day | 0.35 ±0.09 | | 0.90$^{b}$±0.17 | 0.60$^{b}$±0.43 |
| 3 g/bird/day | 0.34 ±0.07 | | 1.81$^{a}$±0.56 | 1.20$^{a}$±0.81 |
| Control | 0.36 ±0.06 | | 0.90$^{b}$±0.85 | 0.60$^{b}$±0.92 |

*- Significant (P<0.05) Mean values having different superscript differ significantly

**Table : Cell Mediated Immune response of Kalmegh supplementation at various levels in Nicobari breeding fowl**

| Treatments | Foot pad thickness (mm) |
|---|---|
| 1 g / bird/day | $0.70^{b}$± 1.17 |
| 3 g/bird/day | $0.91^{a}$±2.12 |
| Control | $0.17^{c}$± 2.15 |

*- Significant (P<0.05) Mean values having different superscript differ significantly

Cell mediated immune response in terms of foot pad thickness was found to be significantly higher with Kalmegh supplementation @ 3 g/bird/day

**Table: HA titre of progeny of Nicobari breeding fowl fed with Kalmegh supplement**

| Treatm-ents | At 12 weeks of age | | | | At 16 weeks of age | | | |
|---|---|---|---|---|---|---|---|---|
| | 0 day | 7th day | 14th day | 21st day | 0 day | 7th day | 14th day | 21st day |
| 3g /bird /day | 0.11 ± 1.17 | $0.55^{a}$ ± 1.12 | 0.20 $^{a}$ ± 1.08 | $0.23^{a}$ ± 0.17 | 0.10 ± 1.31 | $0.38^{a}$ ± 1.17 | $0.26^{a}$ ± 0.81 | $0.25^{a}$ ± 1.21 |
| Control | 0.13 ± 0.27 | $0.3^{b}$ ± 1.02 | $0.10^{b}$ ± 0.17 | $0.10^{b}$ ± 0.07 | $0.11^{b}$ ± 0.09 | $0.20^{b}$ ± 0.48 | $0.10^{b}$ ± 0.27 | $0.10^{b}$ ± 0.16 |

*- Significant (P<0.05) Mean values having different superscripts differ significantly

**Table: Duodenal morphometry of progeny of Nicobari breeding fowl fed with Kalmegh supplement**

| Duodenal parameters | 1 g /bird/day | 3g /bird /day | Control |
|---|---|---|---|
| Crypt depth (µm) | $58.15^{b} \pm 3.42$ | $54.42^{a} \pm 4.81$ | $63.79^{c} \pm 1.72$ |
| Villi Length (µm) | $323.11^{b} \pm 16.48$ | $365.06^{a} \pm 16.0$ | $269.28^{c} \pm 18.48$ |

*- Significant (P<0.05) Mean values having different superscript differs

### ii. Feeding of Kalmegh to Nicobari fowl

Thirty breeding Nicobari fowls belonging to same batch were selected at 35 weeks of age. Birds were managed under

Plate: Kalmegh powder

deep litter system and 16 hours light with 3 lux of intensity per sqft. All birds were fed *ad libitum* as per Bureau of Indian Standards (BIS, 2007) recommendation. Birds were assigned to each of following dietary treatments. **T1:** Breeder diet

supplemented with Kalmegh powder @ 3g per bird per day; **T2:** Breeder diet was supplemented with oral administration (10 ml per bird per day) of Kalmegh extract prepared by soaking 30 g of kalmegh in water; **T3:** Control diet without Kalmegh supplement.

**Biochemical and Micronutrient analysis of serum**

The serum was assayed for Iron, zinc and copper content using Atomic Absorption Spectrophotometry (AAS) and were expressed as ppm and serum total cholesterol, glucose, Bilirubin and SGOT was quantified using ERBA Automatic Biochemistry Analyzer (Transasia Clinical Chemistry Analyser-Model 200) with ERBA kit.

**Serum Biochemical profile upon Kalmegh herbal supplementation**

The cholesterol was significantly ($P<0.01$) lower (105 mg/dl) on third day supplementation of kalmegh in feed; but was no significant difference was observed between kalmegh supplementation in water as compared to control group. Similarly serum cholesterol was significantly ($P<0.01$) lower (99.5 mg/dl) in birds fed kalmegh through feed on fifth day of supplementation as compared to water supplemented and control groups. Birds fed with kalmegh as both water and feed supplement had significantly ($P<0.01$) lowest serum cholesterol of 116 and 110 mg/dl respectively on seventh day of supplementation as compared to control birds. The SGOT was significantly ($P<0.01$) lower in kalmegh as water supplement (173 U/dl) followed by kalmegh as feed supplement (198 U/dl) which was comparable with control group. Significantly ($P<0.01$) lowest SGOT was observed in birds fed with kalmegh

as both water and feed supplement of 182 U/dl and 178 U/dl on fifth day and 185 U/dl and 177 U/dl on seventh day respectively as compared to control groups.The level of serum glucose significantly (P<0.01) differed among kalmegh supplemented and control groups from third day of feeding. The serum bilirubin level was significantly (P<0.01) reduced on fifth and seventh day of supplementation in both water and feed as compared to control group; while there was no significant difference between kalmegh supplemented groups.

**Table . Serum Biochemical profile upon Kalmegh herbal supplement**

| Serum cholesterol (mg/dl) | | | |
|---|---|---|---|
| Day of supplementation | Kalmegh extract prepared @ 50 gm kalmegh powder per 200 ml water | In Feed @ 3g per bird per day | Control |
| 1st NS | 128.28 ± 6.02 | 127.42 ± 7.33 | 126.92 ± 4.79 |
| 3rd ** | 126.67 ± 7.32$^{b}$ | 105.42 ± 4.03$^{a}$ | 125.50 ± 8.59$^{b}$ |
| 5th ** | 128.58± 3.52$^{b}$ | 99.50 ± 7.94$^{a}$ | 133.58 ± 6.53$^{b}$ |
| 7th ** | 116.66± 10.08$^{a}$ | 110.92 ± 8.86$^{a}$ | 151.83± 8.74$^{b}$ |
| Overall mean | 125 | 110 | 134 |
| Serum SGOT (U/dl) | | | |
| 1st NS | 209.90 ± 11.21 | 189.72 ± 17.58 | 203.37 ± 11.36 |

| | | | |
|---|---|---|---|
| 3rd ** | 173.24 ± 3.74[a] | 198.84 ± 13.18[ab] | 204.8 ± 13.84[b] |
| 5th ** | 182.34 ± 10.2[a] | 178.6 ± 8.16[a] | 221.32 ± 14.49[b] |
| 7th ** | 185.85 ± 7.88[a] | 177.42 ± 6.9[a] | 246.9 ± 27.7[b] |
| Overall mean | 187 | 185 | 218 |
| Serum glucose level (mg/dl) | | | |
| 1st NS | 226.10 ± 5.45 | 234.48 ± 4.11 | 239.24 ± 5.04 |
| 3rd ** | 203.47 ± 7.50[a] | 225.32 ± 10.18[b] | 242.54 ± 6.10[b] |
| 5thNS | 228.20 ± 9.92 | 239.05 ± 7.18 | 248.77 ± 6.92 |
| 7th NS | 230.36 ± 9.41 | 235.88 ± 6.77 | 240.18 ± 6.68 |
| Overall mean | 211 | 220 | 242 |
| Serum bilirubin level (mg/dl) | | | |
| 1st NS | 0.066 ± 0.01 | 0.067 ± 0.00 | 0.062 ± 0.01 |
| 3rd NS | 0.052 ± 0.01 | 0.051 ± 0.01 | 0.062 ± 0.01 |
| 5th ** | 0.054 ± 0.01[a] | 0.052 ± 0.00[a] | 0.069± 0.01[b] |
| 7th ** | 0.056 ± 0.01[a] | 0.054 ± 0.01[a] | 0.068 ± 0.01[b] |
| Overall mean | 0.057 | 0.056 | 0.065 |

Values in the same column with different superscripts differ significantly ($p<0.01$)

**Table . Micronutrient profile of serum upon kalmegh feeding**

| Micronutrients (ppm) | Kalmegh extract @ 50 gm per 200 ml water | Control |
|---|---|---|
| Iron | $0.270 \pm 0.03^{a}$ | $0.076 \pm 0.02^{b}$ |
| Copper | $0.456 \pm 0.01^{a}$ | $0.367 \pm 0.01^{b}$ |
| Zinc | $0.12 \pm 0.01^{a}$ | $0.053 \pm 0.00^{b}$ |

Values in the same column with different superscripts differ significantly ($p<0.01$)

Supplementaion of Andrographis panniculata had significantly influenced total Serum iron, copper and zinc. The level of iron, copper and zinc was significantly ($P< 0.01$) higher by 3.5, 1.2 and 2 times respectively with supplementation of *Andrographis panniculata* extract as compared to control.

### iv. Processing of kalmegh powder and serum for Andrographolide quantification

Sample of kalmegh leaves were analysed to assure that they contained active compounds which determine the quality and may contribute to the biological effect. The powdered dried plant of *Andrographis paniculata* (0.5g) was weighed and diluted with 7 ml of methanol. The extract was sonicated in ultrsonic homogenizer for 10 mins. This extract was filtered with Whatman's no.1 filter paper. The volume was made upto 10 ml with methanol. The extract was again filtered using 0.2µm syringe filter. The residue was used for HPLC analysis of andrographolide. The extracted and quantified amount of andrographolide in kalmegh powder was 339 ppm.

The blood samples were collected at three and 24 hours after feeding of Kalmegh extract prepared from two levels (30 g and 50 g) of kalmegh powder. The serum samples were processed for High Performance Liquid Chromatography (HPLC) to quantify Andrographolide. Serum of about 0.5 ml was mixed with 0.5 ml of phosphate buffer (pH 5.8) and 1 ml methanol was added. The tubes were vortexed at 8000 g for 5 min. The supernatant was separated. The concentration of andrographolide in serum collected at 3 hours interval of feeding kalmegh extract prepared from 30g of kalmegh was found to be 67.056ppm; where as it was 151.31 ppm in serum collected at 3 hours interval of feeding kalmegh extract prepared from 50g of kalmegh. There was nil concentration of andrographolide in the serum sample collected at 24 hrs interval.

**Table . The concentration (ppm) and peak areas of Andrographolide present in Kalmegh powder and its efficacy to enrich the serum with Andrographolide in Nicobari fowl**

| Samples | Retention Time (RT) | Peak area | Conc. (ppm) |
|---|---|---|---|
| Kalmegh powder | 4.381 | 17355436 | 339 ± 3.81 |
| Serum collected 3 hrs interval feeding of kalmegh extract -30 gm of kalmegh | 4.371 | 7983943 | 67.056 ± 15.03 |
| Serum collected 3 hrs interval feeding of kalmegh extract -50 gm of kalmegh | 4.397 | 3790720 | 151.31 ± 16.73 |
| Serum collected 24 hrs interval feeding of kalmegh extract | Not detectable amount | | |

*Standard peak area – 2890309 (1 µg/ml); * - Average of three determinations*

★ Based on this study, it is concluded that *Andrographis panniculata* is having hepatoprotective and hypcholesterlemic effect in Nicobari fowl.

★ The circulation of andrographolide in the serum after feeding of *A.panniculata* in Nicobari fowl clearly indicates that it is getting deposited in the developing yolk.

★ Further, it is inferred that the HPLC based method developed in this study for the quantification of Andrographolide in serum can be the base reference for estimation of any bioactive components of medicinal plants in serum.

**v. In ovo - Immunomodulatory effect of Kalmegh (*Andrographis panniculata* Nees) on Expression of Toll-Like Receptors in Nicobari fowl**

*Andrographispaniculata*(AP)haspotentimmunomodulatory role in the native indigenous Nicobari fowl. Toll Like Receptors are innate immune receptors and induce fast and appropriate host defence reaction against pathogens. However, basic information on changes at expression of Toll Like Receptors in progeny from Kalmegh fed breeders is not very well known; the level of in ovo exposure of developing embryo to dietary factors affects subsequent deposition of bioactive componests in tissues of the post-hatch chick. The effects of dietary factors on the avian immune system may be confounded by in ovo exposure. Therefore, the objective of the present study was to examine the effect of in-ovo exposure of embryo to bioactive components present in Kalmegh and Noni and its subsequent effect on TLR expression in post hatch chicks.

Two hundred seventy breeding Nicobari fowls belonging to same batch were selected at 35 weeks of age. Optimal male female ratio was maintained. Birds were managed under deep litter system and 16 hours light with 3 lux of intensity per sqft. Birds were not subjected to vaccination at the start of experiment. All birds were fed *ad libitum* feed as per Bureau of Indian Standards (BIS, 2007) recommendation. Thirty six breeders were assigned to each of following dietary treatments in a completely randomized design with three replicates of 30 birds in each replicate; T1 - Control groups;T2– Kalmegh @ 3g per bird per day;T3: Noni @ 10ml per bird per day. *Ad-libitum* feeding was done under standard mangemental condition. Experimental diet was fed for 60 days. Chicks were hatched out from experimental birds. Chicks were slaughtered by humane method at the age of 21 days. Spleen samples were removed from the chick.

Total RNA was extracted from spleen samples (n=6) of each group by using RNAisoplus (DSS Takara India P Ltd, India) as per the manufacturer's instruction. Quantification of total RNA was done by using Biospectrophotometer (Eppendorf, Germany). cDNA was synthesized from 2 ug of total RNA by using high capacity cDNA synthesis kit (Applied Biosystem, USA) as per the manufacturer's instruction. Primers were synthesized from the sequences mentioned by Michailidis *et al.* (2010) and used in PCR and real-time PCR.

The mRNA expression levels in progeny of control and herbal feeding groups treatment were quantified by Real-time reverse transcriptase (RT)-polymerase chain reaction (PCR) method using ABI Prism 7500 Sequence Detection System in Realplex 4S (Eppendorf, Germany) machine with SYBR green

master mix (DSS Takara India P Ltd, India). Real-time PCR was carried out with 1 ul of cDNA, 5 pmoles of each forward and reverse primers, 5 ul of SYBR green master mix and nuclease free water to make up the volume to 10 ul. Cycling parameters were as follows: an initial denaturation at $95^0$C for 10 min; 40 cycles of $94^0$C for 30s, $58^0$C for 30 sec, $72^0$C for 30 sec. RT-PCR reactions of gene for each sample were done in triplicates in 96-well plates. The relative expression levels for target gene were calculated according to ΔΔCT method. mRNA values from *Andrographis* and *Morinda* fed groups were expressed as relative expression compared to control samples.

Analysis by Real - time PCR revealed that supplementation of Kalmegh and Noni in the breeder diet influenced the expression levels of TLR3, TLR4 and TLR5 in progeny significantly ($P<0.05$) as compared to control. Present study shows that TLR-4 gene expression varied significantly ($P<0.01$) among progeny from herbal fed groups. Progeny from Kalmegh fed breeder showed an up regulation of 9.7 fold in TLR4 gene expression compared to control progeny. On the other hand showed a moderate expression of TLR-4 (5 fold) by noni group when compared to control. Higher TLR-4 expression in progeny from herbal fed breeders indicates it to be having more immunity while the progeny from control group to be the most susceptible. Similarly, expression of TLR3 and TLR5 gene were elevated in the progeny of kalmegh fed breeders by 5.4 and 1.6 fold respectively as compared to control progeny. The progeny from noni supplemented breeders showed moderate expression of TLR3 and TLR5 gene by 2.9 and 0.48 fold when compared to control. With reference to GADPH, the kalmegh supplementation modulated the expression of TLR3, TLR4 and TLR5 receptors by 4.1, 11.4 and 4.1 times while chicks

from noni group could express only TLR4 by 4 times where as the expression levels in chicks from control group was not satisfactory. The present study showed up regulation of TLR genes' expression in the progeny from breeders fed with herbal feed additive having immune modulating properties. Further, kalmegh has shown to be more potent up regulator of TLR gene expression as compared to noni.

Overall, these data suggest that the elevated expression of TLR-3, TLR-4 and TLR-5 genes indicated that supplementing Kalmegh and Noni in breeder diet induces antiviral and antibacterial responses in their progeny. In ovo dietary exposures to bioactive components present in the medicinal plants enhances the expression of TLR gene and systemic inflammatory immune response in chicks. They might be promising alternative medicinal plants for antibiotic growth promoters and commercial immune boosters in the platform of production of antibiotic residue free poultry produce.

## vi. Ethno Veterinary Practices

### Table. Ethno Veterinary Practices used for poultry in South Andaman

| Botanical name and family | Local name | Parts used | Mode of administration | Medicinal uses |
|---|---|---|---|---|
| *Adhatoda vasica* (Acanthaceae) | Vasak, Malabar nut | Leaves | Leaves are fed to the cattle twice a day for 2-3 days. | To cure diarrhea. |
| *Azadiarachta indica* (Meliaceae) | Neem | Leaves | Neem oil | To remove insects from the eyes and to control flies nuisance. |
| *Phyllanthus sps* (Euphorbiaceae) | Pad patti | Leaves | Mix the *Phyllanthus sps* with *Centella asiatica* (medhak bhaji) | To cure diarrhea in poultry. |
| *Vitex trifolia* (Verbenaceae) | Samalu | tubers and leaves | Boiled tubers in water and water is applied and applied turmeric powder for 2-3 days. | To wash the wart in poultry |

## Chapter XII

# NATIVE CHICKEN PRODUCTION OF TRIBAL COMMUNITY OF NICOBAR ISLANDS

The Nicobar district of A&N Islands comprises of 12 inhabited islands scattered in Bay of Bengal between 6˚-10˚ N latitude and 92˚- 94˚ E longitude separated from Andaman group of Islands by 10° Channel. These islands are having 63 percent ST population and the predominant feature of the demography is 'Nicobarese'. Livestock farming is the backbone to ensure nutritional security for tribal farming community of Nicobar group of Islands. Rural poultry among livestock farming is considered to be an important primary source of meeting out egg requirement and constitutes meager portion of meat consumption of tribal population of these Islands.

Major constraints associated with commercial poultry production at the level of tribal farming community are adaptability of farming system of commercial poultry and practical difficulties with establishment of commercial farms in Nicobar Islands due to transportation problems. Hence, household native chicken production in Nicobar group of Islands is the sole option for tribal farming community. Desi including Nicobari fowls form the native chicken production at backyard level contribute significantly in nutritional security of Nicobari tribes. The traditional indigenous poultry production, being integral component in balancing nutrients could be improved by studying the various bottlenecks present in the rural poultry production system of tribal farmers. Very little is known about these traditional rural poultry production system of tribal farming community. Few reports on tribal poultry production system describe them as having a very low productivity, high mortality rates and suffering from inefficient management. The study investigated the present status of indigenous native

chicken production at Nicobari tribal farming community with an aim of formulating strategies to improve its production level by addressing the problems associated with the rural poultry production in tribal farming community of Nicobar Islands.

The study was conducted using the census method of complete enumeration of tribal houses in the 15 tribal tuhets located in Nicobar Islands. A pre tested well structured interview schedule was developed. The interview schedule was prepared in English since the letters of Nicobari language are similar to English and moreover, the Nicobari tribals understand well the English language. Data were collected on production system of rural poultry including feeding, housing and health management by Nicobari tribal farming community. The respondents were personally contacted and rapport was established to get unbiased information.

The result of the study indicated that there was only one kind of native chicken production system in the Nicobar Islands. More than eighty percent of Tribes were having poultry under the free-range low input and backyard system of rearing. It was observed that almost every family in Nicobar Islands is habituated in backyard poultry keeping and the flock size ranged from 6 to 16 chickens. Tribal family poultry comprised of mainly desi birds and Nicobari fowls. Although no definite evidence is available about the origin of this local breeds, ethnic tribal groups seem to have played a significant role for maintaining the uniqueness of the breeds and have been nurtured by Nicobari tribes for years without any introgression from outside. For ethnic Nicobari tribal groups and communities, native Nicobari fowls are of special interest because of their socio-religious use. It was recorded that the indigenous native Nicobari fowls are held in high esteem by the tribal farming community even after establishment of industrial poultry production in these Islands

since native Nicobari fowl exhibit superior adaptability in their habitat and possess the ability to survive, produce and reproduce on low plane of nutrition and sub-optimal management and they possess comparatively higher immunity. Further, cock fighting is a popular sport for the Nicobari tribes and the desi birds are superior to exotic breeds in fighting. As per the 19$^{th}$ census (DAHVS, 2012), the total indigenous poultry population in A&N Islands has been estimated to 10,58,400 that is 98% of the total 10,80,000 poultry population of these Islands. The study indicated that the native chicken is the only source to supply 100% of the total chicken meat requirement of tribal farming community. The present study is also concurrent with the report that 80% of poultry meat come from local scavenging chicken. Moreover, these native Nicobari chickens are less susceptible to diseases as compared to broiler strains.

From the data obtained we observed, tribes provide the hen with bamboo basket or waste tin tubs only for laying eggs and keeping the chicks during night time. Rest of the time these birds scavenge and in night the birds rest on the trees. Tribal farmers feed poultry with rice or coconut due to abundant availability of coconuts in Nicobar Islands. These native birds get maximum nutrients by scavenging. The whole tribal farmers depend on scratch feeding for rural poultry due to non availability of commercial feed in the Nicobar Islands and unawareness on balanced feeding. It was also observed, the birds are not being vaccinated; however the percent survivability was 53.06%, which is fairly higher than few reports.

Information on egg production status in the present study revealed that the average number of eggs laid by a bird per annum is less than 60 eggs; this is much higher to the production levels of desi birds and meets the production levels studies. Cockerels and Pullets weighed about 800 to 900 g at the age of

sexual maturity of 6 months old that might have attributed to low egg production since the adult body weight plays crucial role to precise more number of eggs in a biological productive life cycle of hen. This lower adult body weight again in-turn might be due to improper feeding and health management. Based on this study we could assume that each family on an average receive a total of 300 eggs from an average flock of five birds; but this is too low to meet the ICAR recommendations of 180 eggs per person per annum. Based on the data collected it is revealed that knowledge on crucial role of eggs and chicken meat in their daily nutrition and awareness on egg as a balanced and nutritious food was negligible among 95% of tribal farmers and suggest for creating awareness on nutritive value of eggs from the point of view on close association between awareness on importance of native chicken meat and egg consumption and its production enhancement.

Ninety eight percent of Nicobari tribes were not well aware of intensive chicken production and management. All the tribal homesteads consumed 80% of the eggs laid while 20% were set for hatching under broody hens as marketing of desi eggs is not practised by tribal farming community. Main interest of the tribal farmers having native indigenous poultry is not in production of eggs as source of returns. The major quantities of native and desi chickens such as cock (Meat Birds) after growing up to moderate size are consumed among tribes. Further, it is estimated that apart from exotic breed (broiler type), desi chicken production adds up to 1 ton of meat per year to meet out the consumers preference for desi bird. Indigenous birds are very popular poultry meat in these islands. Many consumers prefer desi chicken more than exotic type. Sensory evaluation study revealed that the native Nicobari fowl are harder than the exotic breeds of broiler and the taste, flavour and juiciness are almost similar to the exotic cockerel stocks.

It has also advocated the suitability of desi chicks from exotic strains for preparation of chicken delicacies due to its desirable flavour, less abdominal fat and juiciness. Rural poultry at present accounts significantly in daily nutrition of tribal people. Most importantly it was observed that the rural poultry produce were of organic in nature among tribal farmers while the demand for organic egg and meat is increasing over the years in the industrially developed countries even though they cost more.

Base on the baseline survey and study, the following major constraints for the development of native chickens among tribal farming community should be given due concern:

1. No shelters for rural poultry and hence birds are vulnerable to predators and the extreme weather conditions.
2. Slow body weight gain, late sexual maturity and low egg production due to failure in supplemental feeding.
3. Risks of high mortality to Newcastle disease due to absence of vaccination
4. Lack of information to upgrade their knowledge on native chicken production
5. Lack of incubation technique for mass production of chicks
6. Lack of brooding technical know-how
7. Lack of medication and vaccination health programme

The native chicken production is an established component and has a crucial role to sustain the nutritional security of Nicobari tribal farming community. For this reason, the necessity for its development has always been recognised but insufficiently pursued. Based on the study on impact of interventions made at rural poultry farming practices, the following strategies are recommended for management of native chickens under improved conditions:

★ Elevated housing : Floor made up of wooden planks and one feet raised from the ground level

- ★ Feeding management using locally made feeder and waterer from wooden material, bamboo and used plastic cans, bottles and waste plates.
- ★ Vaccination**:** Regularly can be done by themselves as a group to prevent the mortality.
- ★ Low cost supplemental feeding using rice, wheat, coconut, fish, fish bone, egg shell and waste vegetables
- ★ Brooding : Confining chicks in an area and providing warmth of broody hen with bulb protects chicks from predators
- ★ Artificial Hatching: Hatching with mini incubator help to increase the number of table eggs and chicks from hen

## Conclusion and Recommendations

The desi and native indigenous chicken dominates poultry production at the Nicobar group of Islands. The growing number of affluent tribal population in Nicobar Islands most likely will demand a richer desi poultry produce. Further, small holding backyard poultry production utilizing native poultry breeds therefore is expected to improve its production; if not well planned the genetic resources of native indigenous Nicobari fowl poultry shall be lost, as it has already happened in most of the Nicobar group of Islands. Conservation of native poultry germplasm should be strengthened through interventions in rural poultry production system among tribal farming community to sustain the socio-religious use of native poultry breeds and their superior adaptability in their habitat. Production improvement of native poultry breeds and their conservation for future use should be on community basis since the Nicobari tribes are living as community.

Production of desi meat and eggs can be enhanced by improving the present management system of rural poultry

production at Nicobari tribes. Improved rural poultry farming practices including development of diets based on locally available feedstuffs, design of cheap housing units and establishment of regular vaccination program will be appropriate systems and approach to native chicken development among Nicobari tribal farming community.



*For detailed information please contact*

**DIRECTOR**
**ICAR- Central Island Agricultural Research Institute**
**Port Blair, P.O.Box. 181**
**Andaman and Nicobar Islands - 744 101, India**
**Website: www.icar-ciari.res.in**