Indian Journal of Animal Sciences **81** (12): 1255–1258, December 2011

Effect of feeding of *Morinda citrifolia* fruit juice on growth, production and immunity of Nicobari fowl

JAI SUNDER[1], A KUNDU[2], D R SINGH[3], S JEYAKUMAR[4] and R C SRIVASTAVA[5]

Central Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands 744 101 India

Received: 9 May 2011; Accepted : 13 May 2011

Key words: Growth, Immunity, *Morinda citrifolia,* Nicobari fowl, Production

Morinda citrifolia, commonly known as great morinda, Indian mulberry, *nunaakai* (Tamil Nadu, India), dog dumpling (Barbados), *mengkudu* (Indonesia and Malaysia), *kumudu* (Balinese), *pace* (Javanese), beach mulberry, cheese fruit, is native from South-east Asia to Australia and is now distributed throughout the tropics. 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 this Island. All the parts of this plant have high demand in alternative medicines and herbal medicines (Bruggnecate 1992, Solomon 1999). However, little or no work has been done or reported on its use in the animals (Sunder *et al*. 2007). Due to its wide range of health benefits and therapeutic value the studies on the effect of feeding of fruit extract to Nicobari fowl was conducted. Nicobari fowl, an endangered indigenous germplasm of Andaman & Nicobar Islands is particularly found in Nicobar group of Islands and is suitable for backyard rearing (Ahlawat *et al.* 2004).

Ripened fruits of *Morinda citrifolia* were crushed to prepare crude fruit juice. Nicobari fowl (60-day-old) were divided into 2 subgroups with 30 birds in each group. Fresh *Morinda citrifolia* fruit juice was given @ 1.5 ml/bird/day to group 1 (Morinda fed group) and birds of group 2 (control group) were kept as control and not given any Morinda juice. All the birds were kept under standard deep litter system of rearing and fed with normal ration. During the whole experimental period no medication, antibiotics, dewormer etc. were given to the birds. Standard feeding and management conditions were precisely followed. Freshwater was given *ad lib.* The body weight, feed conversion ratio (FCR), mortality, egg production, carcass quality, humoral- and cell- mediated immune response were assessed.

The method of Siegel and Gross (1980) with slight modification was followed for assaying the immune response to goat red blood cells (GRBCs). To assess the humoral immune response the haemagglutination test (HAT) was conducted with GRBC in the experimental birds. The goat RBC was used as an antigen and 2% suspension was prepared in PBS (pH-7.2) and injected into wing vein of the birds @ 0.25 ml per bird through I/V route. The blood samples before the injection and at every week interval were taken from each bird till 20th week of age. The sera samples were separated and were assessed for presence of anti GRBC antibodies by HA test. The HA test was carried out in 96 well U shaped microtitre plate. The formation of the button formation was considered as negative. The titre was expressed as the log2 of the reciprocal of the highest dilution giving visual agglutination (button formation) and the data were statistically analyzed.

The *in-vivo* cell mediated immune response to PHA-P (phytohaemagglutinin) was evaluated by the method of Cheng and Lamont (1988). The PHA-P (0.1 mg/ml in PBS) @ of 0.1 ml was injected interdigitally between the third and fourth toe of the right foot of the chicken. The left foot served as control and was injected with 0.1 ml of PBS. The skin index was calculated as the difference between the swelling in the right minus left foot, before and 24 h after the injection and expressed as millimeter.

To study the carcass quality, 5 birds from both the group were slaughtered at 22 weeks of age. After recording, the live weight, the birds were fasted overnight and slaughtered as per Kotula *et al.* (1960). The birds were bled, plucked and later weighed to determine blood and feather losses, carcasses were then eviscerated and weight of dressed carcass were precisely recorded. The weight of giblet was recorded separately. The above components were converted to dressing (%), blood loss, feather loss, head plus feet, giblet.

The growth performances depicting the body weight, feed conversion ratio (FCR) and performance index (PI) at weekly interval are presented in the Table 1.The average adult body weight was highest in morinda fed group than the control group. The highest body weight gain was observed in the

Present address: [1]Senior Scientist (jaisunder@rediffmail.com), Division of Animal Science.

Table 1. Growth performances of different group of birds at different month's interval

Group	Body weight gain(g)			Feed conversion ratio (NS)			Performance index		
	0–3	3–6	0–6	0–3	3–6	0–6	0–3	3–6	0–6
Morinda	738.12±35.95	1125.88 ^{a}±78.97	1864^{a}±89.22	3.27±0.52	5.25±0.27	4.1±0.61	75.01±38.8	69.49±23.17	72.24 ^{a}±20.28
control	765.56±23.11	982.94 ^{b}±69.13	1748.5^{b}±83.22	3.31±0.27	6.16±0.17	4.4±0.73	74.79±39.30	53.46±22.46	53.46 ^{b}±22.46

Means with different superscripts in a column differ significantly (P< 0.05); NS, not significant.

fourth month of age. The average body weight gain in the morinda fed group at the end of fourth month was 587.5 g compared to 578.88 g in control group. The best feed conversion ratio of 2.68 was observed in the morinda fed group in the first month as compared to the control group. In both the group the best FCR was observed in the first month followed by third, second, fourth and fifth months respectively. Overall, the average FCR value of 4.1±0.61 and 4.4±0.73 was observed in the morinda and control group at the end of fifth month respectively. The overall performance index of morinda fed group was found better than the control group. The performance index revealed that at the end of third and fourth month of the growing phase the best performance in both the groups was observed, which is positively correlated with the FCR value and the body weight gain. The performance in terms of the body weight gain reached peak at the end of fourth and declined after sixth month period in birds of both the groups. Sunder *et al*. (2007) reported similar findings in which the feeding of *Morinda citrifolia* induced the body weight gain, and immune response in broiler birds. No significant effect on mortality pattern was observed however, in the Morinda fed group; the mortality was less than the control group. The fruit of *Morinda citrifolia* is very rich in all the essential nutrients, viz. amino acids, vitamins, minerals, coenzymes, carbohydrates, and alkaloids which directly or indirectly helps in metabolism of the nutrients and helps in overall growth of cells and tissues hence, in the morinda fed group the overall performance was better than control group (Singh *et al*. 2008). The highest body weight gain during the 3rd and 4th month of age was observed due to the growing phase of the bird during which the bird attained more body weight gain than compared to the other phase of the growth.

The age at sexual maturity in the morinda fed group was 182 days, however, in the control group it was 185 days. The weight at sexual maturity in the moridna fed group was 1864±89.22 g and in control group it was 1748.5±83.22 g. No significant difference was observed in terms of the weight of the egg in both the experimental group of birds. The hen day egg production (HDEP) revealed that the production increased steadily from second week of egg production to ninth week in birds of both groups. The peak production of 95.24% was achieved in morinda group in the eighth and ninth week of production. In the control group the peak production (83.11%) was observed in the 11th week. Feeding of *Morinda citrifolia* juice enhanced the egg production in Nicobari fowl. The Morinda fruit juice contains several important ingredients which might have played role in the enhanced egg production. Singh *et al*. (2008) reported that the juice contains rich amounts of K, Ca, Mg, Fe, Cu and Mn. The pattern of the egg production in both group of birds revealed that the peak production persists for 2–3 weeks, declined after that and then remained at constant level till the 30th week of egg production. The hen day egg production value of 85% or more should be desirable, however, in the present study at 8–12th week of egg production the value was found more than 85% in the morinda fed group, however in the control group the value was less than the 85%. No significant difference was observed in terms of the quality of the egg produced by both the group, which suggested that *Morinda citrifolia* has no effect on the size and weight of the egg. The reports of Morinda on the growth was reported by Sunder *et al*. (2007) in broiler birds, however, no reports are available on the effect on the egg production in the Nicoabri fowl. The present findings showed the positive effect on the egg production with supplementation of *Morinda citrifolia* juice @ 1.5 ml/bird/day.

The male birds from both the groups were collected at 5 months of age and studied for cut-up parts and dressing %. No significant difference was observed in terms of dressing % of the carcass of both the group, however, highest dressing % was obtained in the morinda group (69.05%) followed by control (68.38%) group (Table 3). The thigh weight and breast weight % of the Morinda fed birds was more than the control birds. However, no significant difference was obtained in terms of the cut-up parts of the both the groups.

The results of the humoral immune response revealed the

Table 2. Means and standard errors of HA titre (log2) of different group of birds

week	HA titre (log2)	
	Morinda	Control
1	0.17±0.25^{c}	0.17±0.25^{c}
2	1.2±0.18^{a}	0.98±0.17^{a}
3	0.875±0.15^{ab}	0.71±0.09^{ab}
4	0.60±0.13^{bc}	0.38±0.13^{bc}
Avg.	0.71±0.19^{a}	0.56±0.15^{b}

**, Means with different superscripts in a column differ significantly (P< 0.05).

Table 3. Carcass characteristics and cut up parts of Black nicobari, Brown nicobari and Barred birds of 22 weeks old

Characteristics	Morinda	Control
Live weight (g)	1864±2.6	1748.5±117.49
Dressed wt (g)	1287±7	1199.75±105.90
Giblet wt (g)	198±7	194±19.55
Feather loss (g)	189±7	160.25±23.50
Blood loss(g)	50±7	51.5±1.84
Head + feet (g)	140±7	143±7.38
Blood loss%	2.68	3.08
Feather loss%	10.14	9.30
Head + feet%	7.51	8.69
Giblet%	10.62	10.54
Dressed%	69.05	68.38
Cut up parts		
Thigh wt (g)	438^{a}±7	366^{b}±36.21
Breast wt (g)	305±7	274.25±21.86
Back +neck wt (g)	367±7	348±16.30
Wing wt (g)	367^{a}±7	143^{b}±13.59
Thigh wt%	34.03	30.39
Breast wt%	23.70	22.82
Back +neck wt%	28.52	29.53
Wing wt%	11.66	12.02

Means bearing common superscripts with in rows do not differ significantly at P<0.05.

appearance of antibody in both the group at first week of post immunization of goat RBC. The results of the HA test with means along with standard errors for antibody response (HA titre) are given in Table 2. The HA titre values in morinda fed group was significantly higher than the control group. The antibody titre reached its peak at 1 week PI in both the groups. The peak log2 titre of the morinda group was the highest among both the groups with peak value of 1.2±0.18 at seventh day P I. Statistical analysis revealed the significant difference (P<0.05) of the HA value at different days of antibody titre in both the group. In the present study the humoral and cellular immune response could be induced by feeding *Morinda citrifolia* juice. As reported the juice is very rich in nutrients and also reported to induced immune response (Hirazamu and Firusawa 1999). The cellular mediated immune response was also assessed by injecting PHA-P through intradermal route in inter-digital space of footpad. The *in-vivo* cell mediated immune response to PHA-P (phytohaemagglutinin) was observed more in morinda fed group (1.73±0.19) than in control group (1.27±0.14). The results indicated that the *Morinda citrifolia* induced cell mediated immune response better than the humoral immune response. The immune response studies revealed higher B cell response in the *Morinda* fed group. A similar finding was also observed by Sunder *et al*. (2007) in the poultry fed with Morinda fruit juice. Reports suggested that *Morinda* is capable of stimulating the release of several mediator from murine effector cells, IL-1, IL-10, IL-12, IFNs and nitric oxide (Hirazamu and Firusawa 1999). They reported that fruit juice contains a polysaccharide rich substance which activates the host immune response.

The overall performance of morinda fed group was better than control group in terms of body weight gain, FCR, mortality% and immune response. The survivability% of the morinda fed group was also found better than control group. The plant was been reported to have a broad range of therapeutic and nutritional values (Whislter 1992). There is a great demand for its fruit juice in treatment for different kinds of illness (Wang *et al*. 2002). In the present study both humoral and cellular immunity was increased by the *Morinda citrifloia*. Locher *et al*. (1995) also reported that Morinda *citrifolia* have a history of use in Polynesian traditional medicine for the treatments of infectious disease. The present study revealed the overall nutritional effect and immune enhancer effect of *M. citrifolia* in poultry. The growth promotion effect of *Morinda citrifolia* juice may be due to its rich nutrients value which contain all the essential amino acids, minerals, vitamins and other nutrients. It is very rich in proxeronine which is believed to be a precursor to xeronine which helps in activation of xeroninase. As the Morinda fruit contain several amino acid, vitamins, minerals, co-enzyme carbohydrates and alkaloids which directly or indirectly help in metabolism of the nutrients and help in overall growth of the cell and tissues hence in the morinda fed group the overall performance was better than in control group. More than 160 neutraceutical compounds were identified from the plant (Solomon 1999). The fruit juice is in high demand in alternative medicine for different kinds of illness. However, very few reports are available on animal science research (Solomon 1999). Leaf and fruit of this plant are reported to be used as feed for livestock and poultry (Fugh-Berman 2003). However, further investigation on several bioactive compounds present in the *M. citrifolia* will help in understanding the actual mechanism in detail and its use in livestock and poultry as a source of vitamins, minerals supplement for higher growth, production and immunity.

SUMMARY

Effect of feeding of *Morinda citrifolia* fruit juice on the growth, production and immune response of Nicobari fowl was conducted. Fresh *Morinda citrifolia* fruit juice was given @ 1.5 ml/bird/day to group 1 (morinda fed group) and group 2 was kept as control. The average adult body weight of male bird was highest in group 1 (1864±89.22 g) than in control (1748.5±83.22 g). The average FCR value was observed best in group 1 than in control group. The peak hen day egg production of 95.24% was achieved in group 1 while in the control group the peak production was observed in the 11th week with a value of 83.11%. Highest dressing % was obtained in the group 1 (69.05%) than in control (68.38%). 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 in the group 1 (2.8±0.02) than in control (1.37±0.18). Based on the finding of the present study it is concluded that feeding of *Morinda citrifolia* @ 1.5 ml/bird /day enhanced growth, production and immune response in Nicobari fowl.

ACKNOWLEDGEMENTS

The authors are grateful to the financial assistance provided by National Medicinal Plant Board, Govt. of India to carry out this work.

REFERENCES

Ahlawat S P S, Sunder J, Kuncu A, Chatterjee R N, Rai R B, Kumar B, Senani S, Saha S K and Yadav S P. 2004. Use of RAPD-PCR for genetic analysis of Nicobari fowl of Andamans. *British Poultry Science* **45**(2): 191–200.

Bruggnecate J T. 1992. Native plants can heal your wounds. *Honululu Star–Bulletin Local News* Feb 2.

Fugh-Berman A. 2003. The 5 minute herbal and dietary supplement consult. *Philadelphia Lippincott* pp 236–37.

Hirazumi A and Furuwawa E. 1999. An immunomodulatory polysaccharide-rich substance from the fruit juice of *Morinda citrifolia* (noni) with antitumour activity. *Phytotherapy Research* **13**: 380–87.

Kotula A W, Thompson J E and Kinner J A. 1960. *Poultry Science* **39**: 226–27.

Locher C P, Burch M T, Mower H F, Berestecky J, Davis H and Van P B. 1995. Anti-microbial activity and anti-complement activity of extract obtained from selected Hawaiian medicinal plants. *Journal of Ethnopharmacology* **49**: 23–32.

Siegel P B and Gross W B. 1980. Production and persistence of antibodies in chickens to sheep erythrocytes. 1. Directional selection. *Poultry Science* **59**: 1–5.

Singh D R, Sunder J and Srivastava R C. 2008. Peptide and mineral profile of *Morinda citrifolia* fruits and leaves. *International Journal of Noni Research* **2**(1–2): 72–78.

Solomon N. 1999. *The Tropical Fruit with 101 Medicinal Uses, NONI Juice*. 2nd edn. Woodland Publishing.

Sunder J, Rai R B, Yasmeen J, Kundu A and Jeyakumar S. 2007. Immunomodualtor effect of *Morinda citrifoila* in poultry. *Indian Journal of Animal Sciences* **77**(11): 1126–28.

Whistler W A. 1992. *Polynesian Plant Introductions.* (Eds) Cox P A and Banack S A. Islands, Plants and Polynesians, Portland, OR, Dioscorides Press.