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Performance and economic evaluation of CARI-Devendra poultry under rural farming conditions

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ABSTRACT

Backyard poultry rearing is a vital source of supplementary income and nutritional security for rural households, yet the productivity of non-descript indigenous birds remains low owing to their limited growth potential and susceptibility to mortality. A front-line demonstration was conducted with 20 farmers to assess the performance of the improved dual-purpose breed CARI-Devendra against the non-descript local breed traditionally reared by farmers. Each demonstration farmer (Demo group, $n = 10$) was provided 25 Day-old chicks of CARI-Devendra along with starter feed, while an equal number of farmers continued rearing their existing non-descript birds as control (Control group, $n = 10$). Body weight was recorded at 1, 4, 8, 12 and 16 weeks of age, and mortality was monitored throughout the rearing period. CARI-Devendra birds recorded significantly higher body weight than the Control group at every stage ($p < 0.001$), with an 18.4 per cent higher weight at 16 weeks. Cumulative mortality was numerically lower in the demonstration group than in the check group, but the difference was not statistically significant ($\chi^2 = 0.19, p = 0.66$), indicating comparable livability of the two breeds under the field conditions. Economic analysis showed a higher net return and benefit : cost ratio for the improved breed, which was attributable mainly to its superior body weight. The results demonstrate that CARI-Devendra is a technically superior and economically viable alternative to non-descript birds for improving rural household income through backyard poultry farming, although its livability advantage needs confirmation in larger trials.

Keywords: CARI-Devendra, Backyard poultry, Front-line demonstration, Body weight, Mortality, Economics

Introduction

Backyard poultry farming occupies a central place in the livelihood portfolio of rural and resource-poor households across India, providing a low-investment, quick-return source of protein and supplementary income. (Islam *et al.*, 2020) [1] However, non-descript indigenous birds traditionally reared under scavenging systems are characterised by slow growth, low body weight and high early mortality, which together limit their contribution to household income. (Sharma *et al.*, 2009) [2] The modern scientific backyard poultry farming started about four decades ago in India with the initiation of research on the development of high performing bird suitable for rural/backyard/village/family poultry farming. (Rajkumar *et al.*, 2021) [3] Indigenous ("deshi") chickens support rural livelihoods and food security through low-input backyard farming, but their poor performance limits their economic potential. Improved varieties have therefore been developed for backyard rearing to boost egg production and better meet consumer demand. (Padhi, 2016) [4] CARI-Devendra (also referred to as CARI-Devendra) is a medium-sized, multi-coloured, dual-purpose chicken variety developed at the Central Avian Research Institute (CARI), Izatnagar, by crossing a coloured synthetic broiler male line with Rhode Island Red females. It combines an attractive plumage preferred by rural consumers, an economical feed conversion ratio, and comparatively better livability under field conditions, along with a moderate egg-laying ability. (Das *et al.*, 2014) [5] Despite these documented advantages, adoption of such improved varieties remains limited in many areas because farmers continue to rear non-descript birds out of habit and lack of exposure to improved technology.

Front-line demonstrations (FLDs) are a proven extension tool for showcasing the performance of improved technologies under actual farmers field conditions and for generating locally relevant evidence to accelerate adoption. The present study was therefore undertaken to demonstrate and evaluate the growth performance, livability, and economic returns of CARI-Devendra against the prevailing non-descript breed under farmers field conditions.

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Materials and methods

Location and selection of farmers

The front-line demonstration was conducted with 20 farmers in Pithoragarh district of Uttarakhand, randomly divided into 2 groups: Demo group, ($n = 10$) and control group ($n = 10$). Farmers who were already rearing non-descript backyard poultry and were willing to participate were selected for the study.

Experimental layout

Each of the Demo group, ($n = 10$), participating farmers was provided 25 Day-old chicks of the improved breed CARI-Devendra along with 5 kg of starter feed (chick cost Rs. 40/bird; feed cost Rs. 440/5 kg). Farmers reared these birds under semi-scavenging backyard conditions alongside their existing non-descript flock, which served as the control group ($n = 10$).

Ethical statement

Day-old chicks (DOCs) were provided to the participating farmers for on-farm testing with the voluntary participation of the farmers. The participating farmers were informed about the purpose, procedures, and management practices involved in the study, and their informed consent was obtained prior to commencement of the trial. No procedures involving pain, distress, or invasive interventions were performed on the birds. The farmers were free to withdraw their participation at any stage of the study.

Data recorded

Average body weight (g) of birds was recorded at 1, 4, 8, 12 and 16 weeks of age, and cumulative mortality (number of birds) was recorded at the same intervals. Economic indicators - gross cost, gross

return, net return and benefit : cost (B:C) ratio - were computed on a per-farmer basis for both groups.

Statistical analysis

Data were analysed using an independent-samples *t*-test (Welch's approximation for unequal variances) to compare mean body weight between the demonstration and check groups at each age interval. (Snedecor *et al.*, 1989) [6] The association between group and mortality was tested using Pearson's chi-square test of independence on a 2×2 contingency table (dead/alive $\times$ group) with one degree of freedom ($df = 1$). All expected cell frequencies were greater than 5, so the test assumptions were satisfied. Yates' continuity-corrected values are also reported, and the difference in mortality is presented with its 95 per cent confidence interval. All analyses were carried out using SPSS software, and differences were considered significant at $p < 0.05$.

Results and discussion

Body weight performance

CARI-Devendra birds recorded significantly higher body weight than the non-descript birds at all stages of observation (Table 1). Mean body weight of CARI-Devendra increased from 94.10 ± 1.91 g at 1 week to 1808.00 ± 22.75 g at 16 weeks, compared with 88.50 ± 1.58 and 1526.50 ± 34.16 g, respectively, in the non-descript group. The superiority of CARI-Devendra increased progressively from 6.33% at 1 week to 18.44% at 16 weeks, with significant differences at all ages ($p < 0.001$).

Table 1. Comparative body weight of CARI-Devendra (Demo) and non-descript (Control) birds

Age	Demo (Mean $\pm$ SD) (g) ($n = 250$)	Control (Mean $\pm$ SD) (g) ($n = 250$)	% Increase	<i>p</i> -value
1 week	94.10 ± 1.91	88.50 ± 1.58	6.33	< 0.001
4 weeks	368.40 ± 7.00	333.50 ± 7.95	10.46	< 0.001
8 weeks	833.70 ± 13.55	729.50 ± 19.07	14.28	< 0.001
12 weeks	1342.50 ± 23.36	1134.50 ± 31.13	18.33	< 0.001
16 weeks	1808.00 ± 22.75	1526.50 ± 34.16	18.44	< 0.001

The progressive increase in body-weight advantage indicates the greater growth potential of CARI-Devendra under the semi-scavenging conditions of the present demonstration. Improved backyard varieties are developed to combine enhanced productivity with adaptability to relatively low-input production systems. (Rajkumar *et al.*) [3] emphasized that improved backyard chicken varieties have considerable potential for increasing productivity, income and nutritional security among rural households in India. The present findings are in agreement with (Haunshi *et al.*) [7] who reported significant differences in body weight between indigenous and improved backyard chicken varieties, with improved varieties generally showing higher body weight at different ages. Similar evidence was reported by (Rajkumar *et al.*) [8] who found that rearing system significantly influenced growth performance of improved rural poultry and confirmed the suitability of improved germplasm under backyard conditions. (Maddheshiya *et al.*) [9] further reported favourable egg-quality

characteristics of CARI-Devendra under backyard conditions, with CARI-Devendra showing superior egg weight, shell weight and Haugh unit compared with other improved varieties. These findings indicate that the productive advantage of CARI-Devendra may extend beyond growth and may be useful for both meat and egg production.

Livability

Cumulative mortality up to 16 weeks was 4.0 per cent (10 of 250 chicks) in the demonstration group and 4.8 per cent (12 of 250 chicks) in the check group (Table 2). Although mortality was numerically lower in CARI-Devendra, by 0.8 percentage points (95% confidence interval: -4.4 to +2.8 percentage points), the chi-square test showed that the difference was statistically non-significant (χ (Sharma *et al.*, 2009) [2] = 0.19, $df = 1$, $p = 0.66$; Yates-corrected χ (Sharma *et al.*, 2009) [2] = 0.05, $p = 0.83$). Mortality was therefore independent of breed, and the two groups showed comparable livability under the conditions of this demonstration.

Table 2. Mortality of CARI-Devendra (Demo) and non-descript (Control) chicks up to 16 weeks of age

Group	Total chicks	Deaths	Mortality (%)
Demo (CARI-Devendra)	250	10	4.00
Control (Non-descript)	250	12	4.80
Chi-square value ($df = 1$)			0.19 ^{NS}
Level of significance			$P = 0.66$ (NS)

(continued on next page)

Chi-square (Pearson) = 0.19, $P = 0.66$; Yates-corrected chi-square = 0.05, $P = 0.83$.

NS = non-significant ($P > 0.05$); * = significant at $P < 0.05$; ** = highly significant at $P < 0.01$.

The absence of a significant difference in mortality does not support reports that CARI-Devendra shows better survivability than non-descript birds under backyard rearing conditions. (Global Agriculture, 2023) [10] The trend in the present study was in the same direction, but it cannot be taken as evidence of a livability advantage.

The mortality under backyard conditions is influenced by several factors, including health care, nutrition, housing, predation and management, and not by breed alone. (Rajkumar *et al.*, 2021) [3] The predation was ranked as important as, or more important than, disease in scavenging poultry systems in India (Conroy *et al.*, 2005) [11], and that it was the main cause of the high mortality recorded there. Because both groups in the present study were reared by the same farmers under semi-scavenging conditions, exposure to predation, weather and disease challenge was probably similar, which may have masked any breed effect. Improvements in husbandry, feeding and health cover are known to raise the performance of native fowl,

(Padhi, 2016) [4] and the starter feed and technical guidance that accompany a demonstration may have kept mortality low in both groups (below 5 per cent).

Importantly, the faster growth of CARI-Devendra was not accompanied by higher mortality, which suggests that the improved breed is at least as well adapted as local birds to farmers' field conditions. The lower mortality observed here should therefore be considered as comparable field-level livability, and not as evidence of any specific genetic mechanism of disease resistance. Larger, multi-location demonstrations with recorded causes of death would be needed to establish whether CARI-Devendra has a true livability advantage.

Economic analysis

The improved breed also produced a favourable economic outcome (Table 3). Net return per farmer was 64.5 per cent higher in the demonstration group (Rs. 4950) than in the check group (Rs. 3010), and the benefit: cost ratio was correspondingly higher (2.62 vs 2.36). This economic advantage arises mainly from the faster growth and greater body weight of CARI-Devendra, which directly raise the marketable output per rupee invested in chicks and feed.

Table 3. Economic analysis of CARI-Devendra (Demo) and non-descript (Control) birds (Rs. per farmer)

Group	Gross cost (Rs. per farmer)	Gross return (Rs. per farmer)	Net return (Rs. per farmer)	B:C ratio
Demo (CARI-Devendra)	3050	8000	4950	2.62
Control (Non-descript)	2200	5210	3010	2.36

Although the improved birds involved greater initial expenditure, the additional investment resulted in greater marketable output. Similar economic benefits from improved backyard poultry have been reported by, (Baba *et al.*, 2015) [12] who documented positive net profit for Vanaraja under cage, deep-litter and semi-intensive systems, with semi-intensive rearing providing favourable economic performance. The improved weight gain and better economic was a result of dissemination and impact of improved backyard chicken varieties in India, highlighting their contribution to rural poultry production and livelihood improvement. (Kumar *et al.*, 2022) [13]

Conclusion

The front-line demonstration established that CARI-Devendra is significantly superior to non-descript backyard poultry in body weight at every growth stage and delivers a substantially higher net return and benefit : cost ratio. Cumulative mortality was numerically lower in CARI-Devendra (4.0 vs 4.8 per cent) but did not differ significantly between the breeds, indicating comparable livability under farmers' field conditions. Wider dissemination of CARI-Devendra among rural and hilly/resource-poor households through structured demonstration and extension programmes can therefore be recommended as an effective strategy for improving household nutritional security and supplementary income through backyard poultry farming.

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