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Comparative Evaluation of Growth, Carcass and Immune Responsiveness Traits in Native Chicken Breeds of India

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ABSTRACT

The present study was conducted on two indigenous layer breeds of India and the aim was to evaluate the data consisted of body weight up to 6 weeks, carcass traits at 5th week of age and immune response traits collected from a generation of Aseel and Kadaknath maintained at the Poultry Research Farm, GADVASU, Punjab. The average body weight of Aseel at 0 day, 1, 2, 3, 4, 5 and 6 weeks of age were recorded as 28.74±0.15, 56.57±0.38, 88.51±0.82, 129.31±1.31, 192.49±1.94, 253.75±2.65 and 346.98±3.93 grams, respectively and the average body weight of Kadaknath upto 6 weeks of age were recorded as 29.05±0.15, 54.75±0.40, 84.44±0.88, 113.49±1.26, 175.27±1.72, 235.38±2.32 and 322.51±1.06 grams. The difference in growth pattern between the layer breeds was not distinct until 3 weeks of age. From 4 weeks onwards Aseel showed linear increase in body weights until 6 weeks. Aseel was superior in different carcass traits viz. live weight (326.23±8.26), dressed weight (231.63±6.41), eviscerated weight (161.97±5.20), breast (37.37±1.84), thighs (28.27±0.96), drumsticks (27±0.96) and legs (55.27±1.88) which were significantly ($p<0.05$) higher than Kadaknath. The weight of different support organs viz. liver, gizzard, lung and intestine were not significantly different between the layer breeds except heart. Immune response to Sheep Red Blood Cells (SRBC) was measured in terms of Haemagglutination titre (HA) at three stages viz. 0 (pre inoculation), 5 and 10 days post primary inoculation (PPI) of SRBC. The HA titre on 10 day was significantly higher in Aseel (1.88±0.10) than Kadaknath (1.09±0.06). The in vivo cell mediated response to mitogen phytohaemagglutinin estimated using foot pad index was significantly higher in Aseel (0.68 mm) than Kadaknath (0.43 mm). Specific immune response to IBDV was estimated by ELISA using commercial test kit. The antibody titre for IBDV got increased during 7, 14, 21 days post immunization (DPI). At 14 DPI the titres were significantly different in two breeds in which Aseel exhibited the higher titre (2.96±0.04) than Kadaknath (2.64±0.06). It was found that at 21 DPI antibody response was highest in the two breeds, but not significantly different. Overall better growth, carcass traits and immune response to IBDV was found in Aseel than Kadaknath.

Key words: *Immune responsiveness, Sheep Red Blood Cell, Phytohaemagglutinin, Aseel, Kadaknath.*

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INTRODUCTION

Poultry has an essential place in India as the eggs and chicken meat are important and rich sources of protein, vitamins and minerals. Poultry production for different economic traits resulted in two major types of chicken i.e. broilers and layers which substantially differ in reproduction rate, body weight gain, longevity, carcass traits, nutritional needs and immune responsiveness. Native chicken breeds of India gaining importance over the years for utilization and conservation purposes due to their unique attributes. Among these two native breeds, the growth rate of Kadaknath breed is significantly lesser as compared to Aseel. These native germplasm are known for their hardiness and adaptability to the tropical conditions of India. Both Kadaknath and Aseel breeds are being used for development of germplasm suitable for backyard poultry farming.

Contagious diseases are accountable for major economic losses in poultry production. Development of stocks resistant to large variety of diseases i.e. general disease resistance, provide a good probability of reducing the expenditure on preventive and vaccination programmes. Incorporation of genetic resistance has several advantages including the enhancement of the immune response to vaccines[8]. Immune responsiveness in poultry can be evaluated by challenging the birds with antigens. These antigens may be causative agent of disease like Marek disease virus, New castle disease virus, but they are expensive, time consuming and will cause morbidity and mortality in flock since they are pathogenic nature. So the appropriate way to study immune-competence in a species is to challenge it with non-pathogenic, non-specific antigen like Sheep Red Blood Cell (SRBC), mollusk Haemocyanin, Chicken Egg White Lysosome and Bacterial Lipopolysaccharids or to measure the level of antibody production against the vaccines. SRBC is the most commonly used antigen to study immune-competence in poultry[30].

However, the studies on early body growth, gain in body weight, carcass and immune responsiveness traits of Kadaknath and Aseel are very limited. The aim of the present study was to evaluate the body growth, various carcass and immune response traits at early ages of Kadaknath and Aseel.

MATERIALS AND METHODS

Ethical approval

Prior permission from Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) was taken for slaughtering of the birds and collection of blood samples under sterile condition to carry out the current research work on 30 birds from each genetic group for carcass and immune responsiveness traits.

Location of the experiment

The present experiment was conducted at Poultry Research Farm of University (Guru Angad Dev Veterinary and Animal Science University) located at Ludhiana.

Experimental animals and condition

A total of birds 335 of Kadaknath and 358 birds of Aseel were hatched and reared from day old to 10th week of age in colony (brooder and grower) cages under deep litter management system. Both the genetic groups were provided ration containing 21 to 22 percent protein upto 8 weeks of age and thereafter containing 17 to18 percent protein in ad libitum quantity. Birds had free access to drinking water round the clock. Management and rearing condition for both the genetic groups were kept similar during the period of experiment.

Traits

Body weight of each individual was recorded on day old and then from 1st week to 6th week on weekly basis. Body weight gain was calculated as the difference between the final and initial weight during each of the weighing periods (weeks) that are between 0 to 1, 1 to 2, 2 to 3, 3 to 4, 4 to 5 and 5 to 6. Thirty birds from each genetic group were slaughtered and different carcass traits were recorded at five weeks of age. A total of 90 birds (30 birds of each breeds) at 7 weeks of age were used for estimation of general immune response to SRBC, in vivo cell mediated immune response

to mitogen Phytohaemagglutinin (PHA-P) and specific immune responses to Infectious Bursal Disease Virus.

Evaluation of carcass traits

The carcass traits were studied at 5th weeks of age in fifty birds from each genetic groups. The prime parts (g) viz. thighs, breast, drumsticks and various organ weights (g) viz. heart, liver, gizzard, lungs, intestines were recorded.

Evaluation of immune responsiveness traits

General immune response to SRBC

A total of 90 birds (30 birds of each breeds) at 7 weeks of age were used for estimation of immune response to SRBC. For the preparation of SRBC suspension blood from healthy sheep maintained at Sheep and Goat farm of University was obtained. About 15 ml blood was collected from the jugular vein in anticoagulant Alsever solution with the help of 18G needle. The red blood cells were washed three times with equal volume of phosphate buffer saline (PBS). After final wash the packed cells were brought to 2.5% and 0.25% vol/vol solution in PBS. At 7 weeks of age chicks were immunized with 0.1 ml of 0.25% SRBC suspension. Prior to injection of SRBC suspension a blood sample was drawn from each chick at 0 day (day prior to inoculation) to measure the base titre level. Then each chick was injected intravenously with 0.1 ml of 0.25% SRBC suspension. Then blood samples were taken from same birds at 5 and 10 days post-primary injection. Blood samples were collected from the wing vein of the chicks with 26G needle without adding any anticoagulant. The clotted blood samples were centrifuged at 4000 r.p.m. for 10 min. to harvest serum. Serum harvested was stored at 4°C. Total antibody titre of antibodies against SRBC was determined as per method described by Martin *et al*[15].

In-vivo cell mediated immune response to Phytohaemagglutinin

A total of 90 birds (30 birds of each breeds) at 7 weeks of age were evaluated for the in vivo cell mediated immune response to mitogen Phytohaemagglutinin (PHA-P). Immune response was evaluated as per the method outlined by Cheng and Lamont[7] using footpad response to mitogen PHA-P. Left foot was used as control in which PBS was injected and right foot was used as test foot in which PHA-P in PBS (1 mg/ml) was injected. Thickness of both feet was measured before injection and 24 hours after injection. Foot index was calculated as:

Foot index= (post inj.-pre inj.) - (post PBS-pre PBS)

Where, Post inj. is the thickness of test foot 24 hours after injection of PHA-P;

Pre inj. is the thickness of test foot before injection of PHA-P;

Post PBS is the thickness of control foot 24 hours post injection of PBS and

Pre PBS is the thickness of control foot before injection of PBS.

Specific Immune Responses to Infectious Bursal Disease Virus

For the comparison of breeds for specific immune response to IBDV, 30 birds from each genetic group were reared. Chicks were vaccinated against Infectious Bursal Disease at 2 weeks of age through drinking water. Blood samples were collected from the wing vein of the chicks with 26G needle without adding any anticoagulant. Prior to vaccination a blood sample was drawn from each chick at 0 day of primary vaccination, to measure the base titre level. Then blood samples were taken from same birds at 7, 14 and 21days post-primary vaccination. The clotted blood samples were centrifuged at 4000 r.p.m. for 10 min. to harvest serum. Serum harvested was stored at 4°C.These serum samples were used for vaccine response study. The antibody titres against Infectious Bursal Disease (IBD) vaccines were determined by ELISA as described by Parmentier *et al*[20]. For this study commercially available IDEXX IBD antibody test kit was used.

Estimation of titre values

The average positive control serum absorbance was calculated using the absorbance values of first two wells of third row and average negative control serum absorbance was calculated using the absorbance values of first two wells of the second row of ELISA plate.

The negative absorbance was subtracted from the average positive absorbance to get the corrected positive control (CPC).

Sample to positive ratio was calculated by subtracting the average negative control absorbance from each sample absorbance. The difference in absorbance obtained was divided by the CPC to get the specific value.

The titre was calculated as follows: S/P = (S-N) / (P-N)

Where, S = sample OD value; N = average negative control;

P = average positive control.

Log_{10} titre = 1.09 (log_{10} S/P) + 3.36

Statistical analysis

The different genetic groups were compared for general immune response to sheep red blood cells, phytohaemagglutinin, and specific immune response to Infectious Bursal Disease Virus, growth and carcass traits by using Analysis of Variance (ANOVA). The significance of difference between breeds was evaluated by Duncan's multiple range tests. Simple correlation estimates were also obtained between growth and immune response traits.

RESULTS AND DISCUSSION

Body weight and growth

Body weight in both the breeds showed an increasing trend upto 6th weeks. The body weight of Aseel at 2, 3, 4, 5 and 6 weeks of age were significantly (P<0.05) higher than Kadaknath. However, there was no significant difference of body weight between these two breeds at day old and 1 week of age (Table 1). The average body weight of Aseel chicken at day old, 1, 2, 3, 4, 5 and 6 weeks of age was higher than the experiment conducted by Sarkar *et al*[24]. Higher average body weight of Kadaknath chicken from day old to 6 weeks of age was observed as compared to the experiment conducted by Thakur *et al*[26]. Similar result was also reported in the present study for body weight of Kadaknath at 0 to 4 weeks by Thakur and Parmar[27]. Result for significantly (p<0.001) higher body weight in Aseel at different ages was reported by Haunshi *et al*[10]. Chatterjee *et al*[6]., observed significantly (P<0.05) higher body weight in Aseel than Kadaknath at 4,8,12, and 16 weeks except at 2 weeks of age. Niranjan *et al*[18] reported significantly different body weight in four chicken varieties.

Table 1: Body weight (Mean±SE) of Aseel and Kadaknath at different age

Age (weeks)	Aseel (g)	Kadaknath (g)
Day old	28.74^{a}±0.15	29.05^{a}±0.15
1	56.57^{a} ±0.38	54.75^{a} ±0.40
2	88.51^{a} ±0.82	84.44^{b} ±0.88
3	129.31^{a} ±1.31	113.49^{b} ±1.26
4	192.49^{a} ±1.94	175.27^{b} ±1.72
5	253.75^{a} ±2.65	235.38^{b} ±2.32
6	346.98^{a} ±3.93	322.51^{b} ±1.06

Means in the same row with different superscripts letters (a, b) were significantly different (P<0.05)

Table 2: Body weight gain (Mean±SE) in Aseel and Kadaknath at different periods

Traits	Aseel (g/week)	Kadaknath (g/week)
BWG 1 week	27.09^{a}±0.42	24.17^{b}±0.39
BWG 2 week	31.03^{a}±0.68	27.60^{b}±0.71
BWG 3 week	37.80^{a}±1.03	28.46^{b}±0.81
BWG4 week	62.61^{a}±1.32	62.53^{a}±1.08
BWG5 week	63.32^{a}±1.32	62.89^{a}±1.11
BWG6 week	93.52^{a}±2.54	76.26^{b}±2.71

Means in the same row with different superscripts letters (a, b, c) were significantly different (P<0. 05)

The body weight was increased linearly in both the breeds (Fig 1). The gain in body weight of Aseel was significantly (P<0.05) higher than Kadaknath between different age groups (Table 2). The difference in growth pattern between the layer breeds was not distinct until 2 weeks of age. From 3 weeks onwards Aseel showed linear increase in body weights until 6 weeks. The rate of increase in body weight from 4 to 6 weeks in Kadaknath was lower.

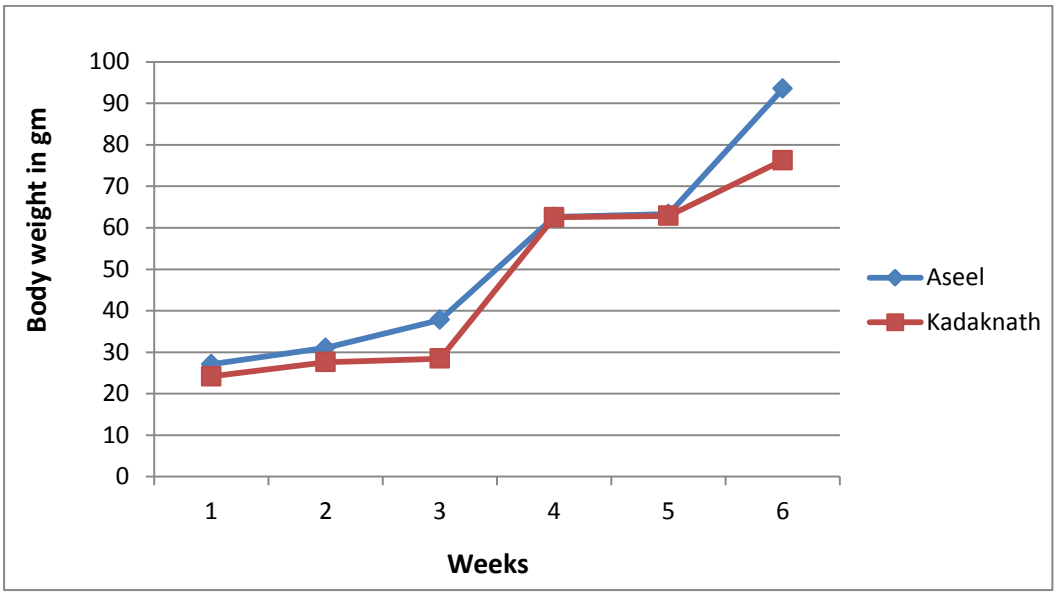

Fig. 1: Body weight gain (g/week) in different poultry stocks

Carcass trait

In this study both the layer and broiler breeds were evaluated for carcass traits. Aseel was superior in different carcass traits *viz*. live weight (326.23±8.26), dressed weight (231.63±6.41), eviscerated weight (161.97±5.20), breast (37.37±1.84), thighs (28.27±0.96), drumsticks (27±0.96) and legs (55.27±1.88) which were significantly (p<0.05) higher than Kadaknath. The weight of different support organs *viz*. liver, gizzard, lung and intestine were not significantly different between the layer breeds except heart. On the contrary Haunshi *et al*[11], reported significantly (p<0.001) higher live weight, ready to cook yield and ready to cook percentage in Aseel and significantly higher abdominal fat percent, giblet, liver, heart (p<0.001) and gizzard (p<0.05) in Kadaknath. Perreault and Leeson[21] Brake *et al*[5]., and Young *et al*[31]., reported that the breast yield increases with age. It has also been reported by Albuquerque *et al*[1]., that the carcass yield in poultry was influenced by slaughter age and better breast yield was seen 49 and 56 days of age.

Table 4: Carcass traits (Mean ± SE) in Aseel and Kadaknath at 5th weeks of age

Traits	Aseel (g)	Kadaknath (g)	IBL-80 (g)
Live weight	326.23^{a}±8.26	293.93^{b}±7.11	915.67^{c}±15.74
Dressed weight	231.63^{a} ±6.41	209.40^{a}±5.66	664.10^{b}±12.09
Eviscerated weight	161.97^{a}±5.20	138.33^{b}±6.02	475.53^{c}±9.88
Heart	2.2^{a}±0.16	1.67^{b}±0.09	7.5^{c}±0.24
Liver	11.03^{a}±0.38	9.97^{a}±0.49	33.6^{b}±0.92
Gizzard	10.37^{a}±0.31	10.13^{a}± 0.27	25.77^{b}±0.68
Lung	2.4^{a}±0.11	1.9^{a}±0.71	5.2^{b}±0.29
Intestine	35.17^{a}±1.07	34.17^{a}±1.12	104.70^{b}±3.97
Breast	37.37^{a}±1.84	26.30^{b}±1.14	124.20^{c}±3.01
Thighs	28.27^{a}± 0 .96	19.73^{b}±0.79	83.73^{c}±1.98
Drumsticks	27^{a}± 0.96	18.30^{b}±0.84	81.90^{c}±2.16
Legs	55.27^{a}±1.88	38.03^{b} ± 1.61	165.63^{c}±4.06

Means in the same row with different superscripts letters (a, b, c) were significantly different (P<0.05)

Immune Response Traits

General Immune response to Sheep Red Blood Cells

Immune response to Sheep Red Blood Cells (SRBC) was measured in terms of Haemagglutination titre (HA) in both the breeds at three stages *viz*; 0 (pre inoculation), 5 and 10 days post primary inoculation (PPI) of SRBC. Haemagglutination titre gives the indication of total antibodies. The means (±SE) for antibody response (HA titre) expressed as $\log_2$ for different genetic groups are given in Table 4. The presence of natural antibodies was evident in the two genetic groups. The mean titre on day 0 was higher in Aseel (0.56±0.05) than Kadaknath (0.34±0.05). The difference among the layer breeds for presence of natural antibodies was statistically significant ($p<0.05$). The HA titre increased post primary inoculation in both the groups and attained highest values on day 10 (Fig 2). Aseel exhibited the higher response on day 5 and 10 post primary inoculation (0.93±0.05, 1.88±0.10) followed by Kadaknath (0.68±0.04, 1.09±0.06). It was reported that antibody titre peaked between 4 to 9 days post primary inoculation of Sheep Red Blood Cells by Vanderzipp and Leenstra[29], Ubosi *et al*[28]., Miller *et al*[16]. Immune response to Sheep Red Blood Cells differed significantly between chicken strains[4,13,14,15,17].

Table 4: Antibody titres (Mean±SE) given primary inoculation of Sheep Red Blood Cells

DPPI	Aseel	Kadaknath
0 (Pre inoculation)	0.56^{a}±0.05	0.34^{b}±0.02
5	0.93^{a}±0.05	0.68^{b}±0.04
10	1.88^{a}±0.10	1.09^{b}±0.06

Means in the same row with different superscripts letters (a, b, c) were significantly different ($P<0.05$)

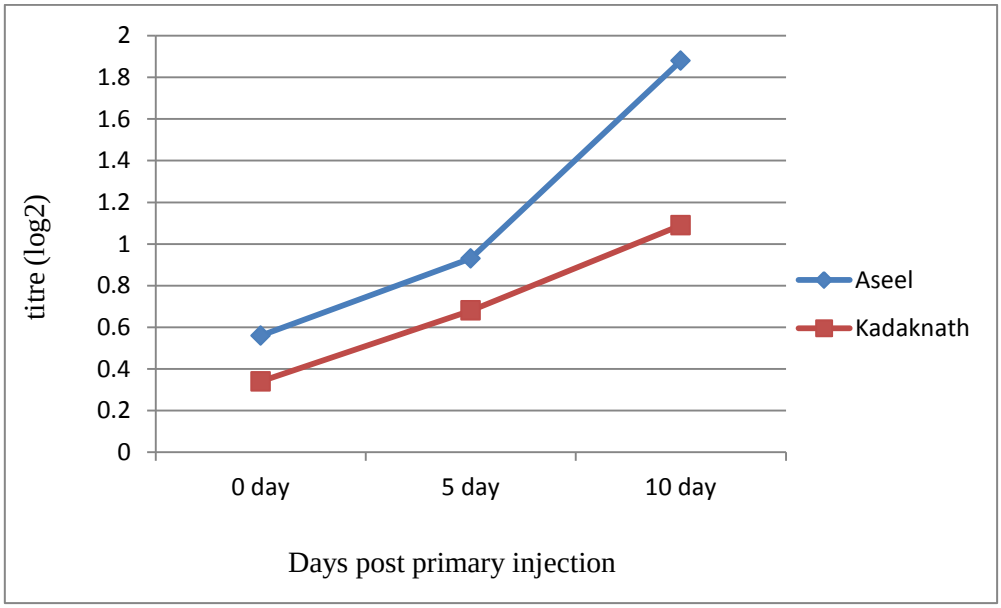

Fig. 2: Antibody titres at different periods given primary inoculation of Sheep Red Blood

Response to Phytohaemagglutinin (PHA-P)

In vivo cell mediated immune response to mitogen, phytohaemagglutinin (PHA-P) was used as an indicator of general cellular immune responsiveness. The response to phytohaemagglutinin and various measurements obtained are presented in Table 5. After PHA-P inoculation the foot web thickness was higher in Aseel than Kadaknath. The response, calculated as difference between increase in foot web thickness due to PBS and PHA-P, was highest in Aseel (0.68 mm)

followed by Kadaknath (0.43 mm).There was significant difference between the layer breeds for response to phytoheamagglutinin. The *in vivo* cell mediated immune response to mitogen is studied by various workers[9,19,22].

Table 5: Response to Phytohaemagglutinin (PHA-P) in different breeds

Traits	Aseel	Kadaknath
PBS	0.41^{a}±0.05	0.27^{b}±0.02
PHA	1.10^{a}±0.08	0.70^{b}±0.06
Response	0.68^{a}±0.07	0.43^{b}±0.05

Means in the same row with different superscripts letters (a, b, c) were significantly different (P<0.05)

Immune Responses to Infectious Bursal Disease Virus

Specific immune responses to Infectious Bursal Disease virus was measured by Enzyme-Linked Immunosorbent Assay (ELISA) for the detection of antibodies against IBDV. The antibody titres against IBDV in different breeds were evaluated at four stages *viz*; 0 (pre inoculation), 7, 14 and 21 days post immunization. The changes in total antibody titre at different days post immunization are indicated in Table 6. The titre values for IBDV were lowest before immunization and got increased during 7, 14, 21 DPI. The peak titre was observed at 21 DPI in the two native breeds, however differences in titre value at 21 DPI in the two breeds were not significantly different. At 14 DPI the titre value were significantly different in both the breeds in which Aseel exhibited the higher titre value (2.96±0.04) than Kadaknath (2.64±0.06). The antibody titre followed an increasing trend in both the breeds at different DPI (Fig 3) and it was almost same at 21 DPI. The specific immune response to IBDV is studied by various workers[3,12,23,25]. Aricibasi *et al*[2]., reported no significant differences in induction of the IBDV-specific humoral response between broiler and layer type birds.

Table 6: Antibody titres (Mean ± SE) at different periods given IBD vaccine

DPI	Aseel	Kadaknath
0 (prior vaccination)	0.56^{a}±0.05	0.54^{a}±0.06
7	1.71^{a}±0.07	1.54^{a}±0.10
14	2.96^{a}±0.04	2.64^{b}±0.06
21	3.27^{a}±0.04	3.17^{a}±0.03

Means in the same row with different superscripts letters (a, b) were significantly different (P<0.05)

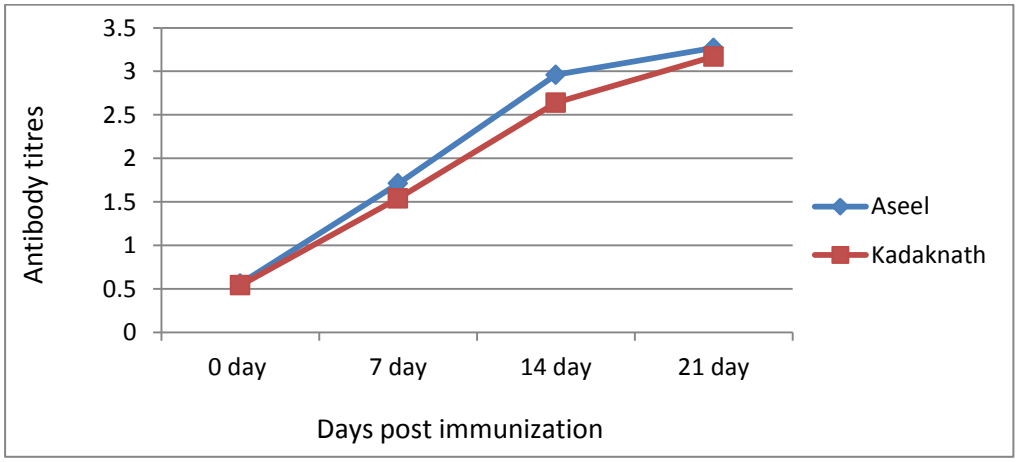

Fig. 3: Antibody titres at different periods given IBD vaccine

CONCLUSION

The result of this study indicated that these two native breeds are differed in growth rate, carcass traits as well as various immune responsiveness traits. The growth at different age groups and carcass traits were higher in Aseel as compared to Kadaknath. It was also found that different immune responses to Sheep red blood cells, PHA-P and IBDV vaccine were higher in Aseel than Kadaknath. This study may help in purpose based backyard poultry farming in the country.

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