P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 8; SP-Issue 3; March 2025; Page No. 23-32

Received: 18-12-2024
Accepted: 26-01-2025

Indexed Journal
Peer Reviewed Journal

Effect of dietary supplementation of germinated maize on laying performance and egg parameters in Kadaknath layers

Akhelesh Kumar Karoriya, Archana Jain, Laxmi Chouhan, Jyotsana Shakkarpude, Rakesh Kumar and Rahul Chaurasia

Department of Veterinary Physiology and Biochemistry, College of Veterinary Science & A.H., MHOW Nanaji Deshmukh Veterinary Science University, Madhya Pradesh, India

DOI: https://doi.org/10.33545/26180723.2025.v8.i3Sa.1717

Corresponding Author: Akhelesh Kumar Karoriya

Abstract

Kadaknath is a renowned Indian poultry breed known for its superior meat quality. However, it has certain drawbacks, including low egg production, slow growth rate, smaller body size, and delayed sexual maturity. To enhance growth and improve meat and egg production, various feed additives such as antibiotics, probiotics, enzymes, vitamins, hormones, and medicinal plants have been used. One effective method to boost nutrition is grain germination. Currently, maize serves as the primary energy source in poultry diets. Germination enhances the nutritional value of grains by breaking down complex compounds into simpler, more digestible forms while reducing the impact of anti-nutritional factors. In an experiment, 128 day-old Kadaknath female chicks from the same hatch were selected. Upon arrival, they were weighed and randomly assigned to four treatment groups—T0, T1, T2, and T3. Each group was further divided into four replicates of eight chicks each. The T0 group served as the control, while T1, T2, and T3 were provided with germinated maize at 50%, 75%, and 100% of the total cereal component, respectively. The results showed that supplementing diets with 50% and 75% germinated maize significantly improved laying performance and increased egg production. All egg quality parameters showed notable enhancement, leading to better economic returns. This approach proved particularly beneficial for backyard farmers raising Kadaknath birds, offering a cost-effective and efficient feeding strategy.

Keywords: Maize, germination, Kadaknath, egg parameters, economics

1. Introduction

Poultry farming, which includes raising chickens, turkeys, ducks, and other birds, is a vital part of animal husbandry. Backyard poultry is widely adopted by poor and marginalized rural households across India, as it provides nutritional security, reduces livelihood vulnerability, and supports gender equity (Dolberg, 2004; Ahuja, 2004; Ahuja and Sen, 2007) [8, 3, 4]. While indigenous poultry was once considered economically unviable, recent evidence challenges this perception. Kadaknath, also known as Kalamashi, is a unique Indian poultry breed recognized for its black-colored meat. However, it has certain limitations, such as low egg production, slow growth, smaller body size, and late sexual maturity. This breed is primarily found in Madhya Pradesh (Jhabua and Dhar) and parts of Gujarat and Rajasthan, with three color variations: jet-black, pencilled, and golden. The black coloration of its meat is attributed to melanin deposition in connective tissues and the dermis (Rao and Thomas, 1984) [29]. Despite its dark appearance, Kadaknath meat is known for its rich flavor and medicinal value, making it highly sought after (Panda and Mahapatra, 1989) [25]. It is also an excellent source of protein (25.47%) and iron, with reputed aphrodisiac properties (Mohan *et al*., 2008) [22]. Additionally, the breed demonstrates strong resistance to diseases and adapts well to extreme climatic conditions, thriving even under suboptimal housing and feeding conditions (Thakur *et al*., 2006) [34]. Given its nutritional and medicinal benefits, systematic evaluation of its growth and production traits is essential. The practice of sprouting grains has been found to enhance their nutritional content by increasing enzyme activity, protein, and vitamin levels. Maize, a commonly used poultry feed, is a crucial energy source due to its high digestibility and lack of anti-nutritive factors, unlike wheat, barley, and oats. Its nutritional value depends on processing techniques such as milling, oil extraction, starch separation, and germination. The use of germinated maize has been shown to improve digestibility and poultry performance, making it a valuable feed option for Kadaknath farming.

2. Materials and Methods

The Institutional Ethics and Animal Welfare Committee approved (No. 343a/ Ethical/18) the experimental procedures. The experiment was carried out in the department of veterinary Physiology and Biochemistry along with Poultry Science, College of veterinary Science & Animal Husbandry, Mhow (MP).

2.1 Experimental design, animals and diets

A total of 128 day old Kadaknath female chicks belonging to same hatch were used for the experiment. On arrival, the chicks were weighed and equally distributed randomly into

four treatment groups T0, T1, T2, and T3. Each group was divided into four replicates of 8 chicks each. Group T0 is kept as control. Groups T1, T2, and T3 were supplemented with germinated maize @ 50%, 75% and 100% of total cereal component.
The experimental chicks were kept in four different pens and provided one square feet floor space to each bird. Each pen was partitioned for each treatment group to have 4 replications accommodating 8 birds in each replication.

2.2 Nutrient Composition of Experimental ration
All the feed ingredients were purchased from the Local market and chick, grower and layer rations were prepared as per requirement (BIS, 2012) [5] having CP 20 per cent, ME 2800 Kcal/kg, CP 16 per cent, ME 2500 Kcal/kg and 18 per cent, ME 2600 Kcal/kg, respectively, in the Department of Poultry Science, Veterinary College, Mhow (M.P.).

2.3 Feeding and watering schedules
Feeding schedule for the birds was designed in three phases. First is the chick ration which was fed from 0-8 week, the second which is grower ration, fed from 9-20 week of age and last one is layer ration, was fed from 20-32 weeks, weighed amount of ration was given every day in morning to all the treatment groups. The left over feed was collected and weighed separately on every week to calculate the actual weekly feed consumption. Same feed was used having different levels of germinated and non-germinated maize as per design of experiment in all the groups. The birds were offered *ad lib* fresh and clean water throughout the experimental period.

2.4 Observations to be recorded
1. **Weekly Cumulative feed Consumption (g):** Record of weekly feed offered and feed leftover from different treatment groups were maintained Cumulative feed consumption of particular week was calculated by adding up the weekly feed consumption of previous week with the feed consumption of the particular week. The data obtained was used for the calculation of average weekly feed consumption of Kadaknath which was calculated by subtracting left over feed at the end of week from the total feed offered in each treatment group during a particular week.

Feed consumed in week = feed offered in week – residue left at the end of week

2. **Age at first Laying:** Calculate the days from zero day to the day at which laying starts.
3. **Total number of egg produced:** was checked every day after 1st laying.

4. **Egg Parameters**
- Egg weight (g)
- Egg shell weight (g)
- Egg shell thickness: by Vernier Calliper's.
- Egg volume (ml)
- Albumin volume (ml)
- Yolk volume (ml)

5. **Economics of Kadaknath Production:** The economics of egg production in Kadaknath layers for experimental period of 110 days was calculated by taking into account the cost of chicks, cost of feed consumed by birds, supplementation cost and miscellaneous expenditure. The cost of production per bird was calculated. Net profit per bird on egg production basis of Kadaknath bird was calculated after sell of egg at prevailing rates in the local market.

2.5 Statistical analysis
The data was subjected to analysis of variance (Snedecor and Cochran, 1994) [33] to compare different treatment groups among themselves and with control.

3. Results
3.1. Weekly Body weight (g)
The supplementation of germinated maize in the diets of Kadaknath chicks at 50, 75 and 100% levels of the grain parts showed very encouraging results. The results obtained for weekly body weight in the present experiment for Kadaknath chicks are presented in Table 02 and Figures 02. The mean body weight were showing a significantly ($P<0.01$ and $P<0.05$) increasing trend from 20 to 32 weeks of age in chicks in all the treatment groups (T1, T2 and T3) as compared to control group (T0). The body weights were 1296.44±6.26 g to 1521.71±8.86 g with lowest in group T0 and highest in T2 at 32 weeks of age.

Table 17: Effect of germinated maize on weekly body weight (g) of Kadaknath (Mean ± SE)

Week	T0 (control)	T1	T2	T3	
0	30.48 ±0.11	30.51 ±0.19	30.41 ±0.15	31.12 ±0.77	NS
1st	54.52 ^{a} ±0.05	57.29 ^{b} ±0.34	62.03 ^{d} ±0.94	59.55 ^{c} ±0.69	**
2nd	83.31 ^{a} ±0.52	101.56 ^{c} ±0.33	101.96 ^{c} ±0.63	94.83 ^{b} ±0.34	**
3rd	117.64 ^{a} ±0.82	134.92^b ±1.08	145.48^c ±1.15	135.99^b ±1.36	**
4th	154.57^a ±1.52	174.81^b ±1.58	195.15 ^{c} ±1.76	172.14^b ±0.87	**
5th	193.95^a ±1.37	227.34^b ±2.03	249.17^c ±2.34	227.72^b ±2.42	**
6th	236.24^a ±1.97	267.41^b ±2.35	306.98^c ±2.71	238.26^a ±2.33	**
7th	289.43^a ±2.12	299.11^a ±2.58	352.24^b ±4.18	288.77^a ±3.18	*
8th	341.94^a ±2.43	383.69^c ±5.43	436.80^d ±4.63	356.71^b ±2.51	**
9th	396.16^a ±4.79	452.00^b ±7.24	515.13^c ±5.25	411.54^a ±4.30	**
10th	462.95^a ±4.67	526.99^c ±2.98	596.40^d ±3.99	479.53^b ±3.39	**
11th	533.79^a ±2.98	613.85^c ±4.14	688.24^d ±4.83	555.94^b ±4.33	**
12th	602.16^a ±4.93	709.84^c ±6.18	766.36^d ±2.87	624.29^b ±4.76	**
13th	672.55^a ±4.85	768.77^c ±6.08	871.68^d ±5.15	694.27^b ±5.23	**
14th	754.39^a ±5.55	860.85^b ±4.28	941.65^c ±3.21	768.59^a ±6.50	**
15th	802.40^a 4.66	926.31^c ±4.76	970.95^d ±4.85	830.39^b ±4.29	**
16th	834.90^a ±5.81	980.58^c ±4.46	1023.66^d ±4.87	878.16^b ±5.92	**

**Shows Significance at 1% level as compared to control group ($p<0.01$)
*Shows Significance at 5% level as compared to control group ($p < 0.05$)

- The values with the different superscripts in a row are different significantly between groups.
- The values with the no superscripts in a row are having no significant relationship.

Table 1: Effect of germinated maize on weekly body weight (g) of Kadaknath (Mean ± SE)

Week	T0 (control)	T1	T2	T3	
17th	878.16^{a} ±5.92	1015.88^{c} ±4.67	1079.12^{d} ±6.13	924.17^{b} ±5.48	**
18th	956.53^{a} ±4.63	1071.25^{c} ±3.30	1125.9^{d} ±5.34	982.96^{b} ±4.32	**
19th	1012.06^{a} ±5.37	1101.29^{c} ±4.05	1183.92^{d} ±6.50	1050.35^{b} ±3.92	**
20th	1047.27^{a} ±5.04	1150.14^{c} ±8.80	1221.82^{d} ±7.58	1080.43^{b} ±3.79	**
21st	1083.08^{a} ±4.35	1174.31^{c} ±3.83	1255.57^{d} ±6.42	1121.59^{b} ±6.97	**
22nd	1118.13^{a} ±4.65	1208.21^{c} ±4.12	1283.68^{d} ±5.20	1152.16^{b} ±5.96	**
23rd	1144.27^{a} ±5.01	1235.82^{c} ±3.57	1320.70^{d} ±6.32	1174.81^{b} ±3.74	**
24th	1168.34^{a} ±3.65	1271.68^{b} ±3.53	1335.65^{c} ±4.93	1203.00^{a} ±5.13	**
25th	1189.55^{a} ±3.67	1295.56^{c} ±5.19	1354.30^{d} ±4.65	1227.04^{b} ±4.79	**
26th	1217.33^{a} ±5.16	1326.08^{c} ±4.13	1377.63^{d} ±4.80	1252.03^{b} ±4.61	**
27th	1237.56^{a} ±4.80	1350.74^{c} ±5.16	1406.51^{d} ±4.57	1274.29^{b} ±4.51	**
28th	1264.68^{a} ±8.87	1361.13^{c} ±4.87	1413.37^{d} ±5.42	1282.97^{b} ±5.03	**
29th	1268.05^{a} ±4.34	1377.53^{c} ±6.11	1429.86^{d} ±5.81	1292.45^{b} ±3.79	**
30th	1273.62^{a} ±3.66	1383.76^{c} ±4.41	1437.78^{d} ±5.78	1310.17^{b} ±5.08	**
31st	1288.62^{a} ±5.19	1397.98^{c} ±4.43	1457.91^{d} ±6.85	1325.19^{b} ±4.90	**
32nd	1296.44^{a} ±6.26	1418.17^{c} ±4.72	1521.71^{d} ±8.86	1332.22^{b} ±5.94	**

**Shows Significance at 1% level as compared to control group (P <0.01)

*Shows Significance at 5% level as compared to control group (P < 0.05)

- The values with the different superscripts in a row are different significantly between groups.
- The values with the no superscripts in a row are having no significant relationship.

3.2 Cumulative feed consumption (g)

The mean cumulative feed consumption for group T0 were ranged from 4939.05±18.28 to 17900.22±56.10, for T1 the range was 5385.09±18.88 to 15297.54±42.23, for T2 the range was 5933.39±23.71 to 14348.71±52.74 and for T3 group, the cumulative feed consumption ranged from 4854.11±19.47 to 16673.74±47.46 from 21st to 32th weeks of age, respectively (Table 02).

The differences between all the treatment groups were highly significant. This may be due to enzyme might have caused certain alterations which changes the demand of the feed in the digestive tract of birds to act upon them for digestion and utilization. The most important reason may be the presence of β-glucanase enzyme which may increase fiber digestion and release the energy ME of feed. The differences between all the treatment groups were found highly significant (p<0.01).

Table 2: Effect of germinated maize on weekly cumulative feed consumption (g) of Kadaknath (Mean ± SE)

Week	T0 (control)	T1	T2	T3	
1st	77.21 ±0.84	77.80 ±1.18	78.83 ±1.06	79.49 ±1.12	NS
2nd	154.29 ±1.72	149.69 ±1.17	148.98 ±1.21	151.44 ±1.32	NS
3rd	234.33^{a} ±1.55	227.21^{bc} ±1.34	220.72^{c} ±1.79	230.93^{ab} ±1.33	**
4th	345.68^{a} ±2.31	329.60^{b} ±2.14	308.69^{c} ±3.21	336.80^{ab} ±3.99	**
5th	459.29 ±5.39	453.18 ±2.57	451.86 ±4.92	454.60 ±3.24	NS
6th	630.54^{a} ±4.39	622.35^{a} ±6.21	596.52^{b} ±6.41	623.92^{a} ±4.59	*
7th	780.96^{a} ±6.60	760.72^{a} ±5.68	713.16^{b} ±9.79	778.69^{a} ±7.11	*
`8th	1050.15^{a} ±8.79	952.20^{bc} ±13.31	912.93^{c} ±15.65	991.94^{b} ±15.50	**
9th	1314.24^{a} ±12.21	1254.49^{b} ±15.58	1133.86^{c} ±14.85	1282.36^{ab} ±12.69	**
10th	1645.48^{a} ±23.60	1563.16^{b} ±18.17	1413.58^{c} ±18.28	1636.69^{a} ±15.75	**
11th	1921.85^{a} ±18.24	1819.17^{b} ±21.79	1711.26^{c} ±21.18	1873.88^{ab} ±13.07	**
12th	2291.06^{a} ±19.42	2216.75^{b} ±21.78	2068.26^{c} ±18.99	2260.86^{ab} ±23.29	**
13th	2665.47^{a} ±23.15	2511.66^{b} ±23.84	2380.93^{c} ±25.41	2634.24^{a} ±17.62	**
14th	2924.08^{a} ±16.72	2802.72^{b} ±13.81	2730.78^{c} ±27.40	2855.91^{b} ±17.73	**
15th	3122.19^{a} ±18.48	3085.62^{a} ±20.43	3005.59^{a} ±24.44	3099.1^{a} ±23.96	*
16th	3416.29^{a} ±20.40	3346.26^{b} ±23.42	3256.89^{c} ±18.09	3377.51^{ab} ±20.56	**
17th	3618.61^{a} ±26.81	3547.49^{bc} ±18.07	3493.08^{c} ±18.15	3594.79^{ab} ±21.41	**
18th	3902.98^{a} ±18.25	3830.85^{b} ±22.92	3748.89^{c} ±21.09	3885.34^{ab} ±18.87	**
19th	4221.84^{a} ±26.95	4153.20^{b} ±21.97	4301.41^{c} ±21.69	4175.15^{b} ±25.94	**
20th	4544.30^{a} ±22.14	4453.66^{b} ±18.60	4914.13^{c} ±24.48	4466.64^{b} ±21.96	**

**Shows Significance at 1% level as compared to control group (P <0.01)

*Shows Significance at 5% level as compared to control group (P < 0.05)

- The values with the different superscripts in a row are different significantly between groups.
- The values with the no superscripts in a row are having no significant relationship.
- Bold - start laying

Week	T0 (control)	T1	T2	T3	
21st	4939.05^{a} ±21.518.028	5385.09^{b} ±18.88	5933.39^{c} ±23.71	4854.11^{a} ±19.47	**
22nd	5320.50^{a} ±12.66	6207.20^{c} ±16.81	6779.71^{d} ±16.43	5738.84^{b} ±46.04	**
23rd	6380.51^{a} ±18.02	7271.68^{c} ±23.17	7581.76^{d} ±25.63	6685.35^{b} ±21.49	**
24th	7508.53^{a} ±19.44	8391.81^{c} ±18.49	8262.69^{c} ±22.94	7716.49^{b} ±28.23	**
25th	8723.75^{a} ±38.68	9290.20^{b} ±37.15	8941.33^{a} ±37.95	8883.31^{a} ±33.55	*
26th	9966.31^{a} ±35.43	10045.08^{c} ±38.64	9729.98^{b} ±37.92	9613.85^{b} ±42.11	**
27th	10736.49^{a} ±31.15	10987.09^{c} ±35.47	10467.47^{b} ±36.62	10599.11^{b} ±45.02	**
28th	11897.25^{b} ±24.37	11944.06^{b} ±37.48	11140.05^{c} ±37.12	12189.76^{a} ±28.50	**
29th	12917.26^{b} ±31.35	12820.09^{b} ±49.12	11967.45^{c} ±38.70	13340.30^{a} ±28.16	**
30th	14350.18^{a} ±65.58	13791.58^{b} ±49.49	12068.55^{c} ±37.08	13962.63^{b} ±38.35	**
31st	15994.41^{a} ±60.06	14844.28^{c} ±47.52	12792.67^{d} ±48.83	15270.28^{b} ±53.03	**
32nd	17900.22^{a} ±56.10	15297.54^{c} ±42.23	14348.71^{d} ±52.74	16673.74^{b} ±47.46	**

**Shows Significance at 1% level as compared to control group (P <0.01)

*Shows Significance at 5% level as compared to control group (P < 0.05)

- The values with the different superscripts in a row are different significantly between groups.
- The values with the no superscripts in a row are having no significant relationship.

3.3 Total Egg Production and age at first laying

The total egg production in kadaknath layers in T0, T1, T2 and T3 groups were 896, 1185, 1298 and 1039, respectively after 110 days of laying. The total egg production in percentage was 30.8, 40.73, 44.62 and 35.72, respectively, for T0, T1, T2 and T3 groups. The total egg production i.e. number of eggs produced were increase in all the treated groups of Kadaknath layers as compared to the control group with the highest number of eggs produced by T2 group followed by T1 and T3.

The age at first laying was 5 month 15 days, 5 month 3 days, 4 month 21 days and 5 month 8 days for T0, T1, T2 and T3, respectively.

3.4 Egg parameters

3.4 .1. Egg weight and egg volume

The mean values of egg weight of groups T0, T1, T2 and T3 were 43.55±0.20, 45.40±0.14, 46.70±0.22 and 45.15±0.10, respectively, after 110 days of study. There was a significant change (P<0.01) in Egg weight in all treated groups as compared to control group (Table 03 and Figure 01).

The mean values of egg volume for groups T0, T1, T2 and T3 were 38.35±0.24, 39.80±0.25, 40.73±0.14 and 39.70±0.08, respectively, after 110 days of study. There was significant increase (P<0.05 and P<0.01) in egg volume in all supplemented groups as compared to control group (Table 03 and Figure 02) from 45 days onwards.

Table 3: Effect of germinated maize on egg parameters in Kadaknath layers every fortnightly after start of laying (Mean ± SE)

Egg weight (g)	15 Days	30 Days	45 Days	60 Days	75 Days	90 Days	105 Days	110 Days
T0	35.16^{a} ±0.29	37.88^{a} ±0.75	40.18^{a} ±0.21	41.18^{a} ±0.16	42.16^{a} ±0.26	43.18^{a} ±0.40	43.25^{a} ±0.20	43.55^{a} ±0.20
T1	37.10^{b} ±0.35	38.45^{a} ±0.53	41.31^{b} ±0.24	42.50^{b} ±0.44	43.44^{bc} ±0.29	44.30^{b} ±0.09	44.70^{b} ±0.20	45.40^{b} ±0.14
T2	37.61^{b} ±0.23	38.85^{b} ±0.15	41.95^{b} ±0.41	43.35^{b} ±0.25	44.35^{c} ±0.23	44.95^{c} ±0.13	45.68^{c} ±0.13	46.70^{c} ±0.22
T3	35.73^{a} ±0.14	38.30^{a} ±0.22	40.53^{a} ±0.14	41.75^{a} ±0.07	43.38^{b} ±0.25	43.29^{a} ±0.23	44.11^{b} ±0.10	45.15^{b} ±0.10
Egg Volume (ml)	**	*	**	**	**	**	**	**
T0	31.33 ±0.08	32.65^{a} ±0.29	34.95^{a} ±0.44	36.15^{a} ±0.13	37.13^{a} ±0.14	37.75^{a} ±0.34	37.85^{a} ±0.23	38.35^{a} ±0.24
T1	31.83 ±0.16	33.23^{ab} ±0.16	35.80^{ab} ±0.18	37.10^{b} ±0.30	38.15^{b} ±0.14	38.87^{b} ±0.36	39.08^{b} ±0.29	39.80^{b} ±0.25
T2	31.96 ±0.36	33.88^{b} ±0.45	36.23^{b} ±0.28	37.75^{b} ±0.29	38.93^{c} ±0.17	39.43^{c} ±0.08	39.86^{b} ±0.24	40.73^{c} ±0.14
T3	31.39 ±0.12	32.70^{a} ±0.18	35.25^{a} ±0.18	36.35^{a} ±0.13	37.93^{b} ±0.17	37.80^{a} ±0.14	38.55^{b} ±0.23	39.70^{b} ±0.08
	NS	NS	*	**	**	*	**	*

**Shows Significance at 1% level as compared to control group (P<0.01)

*Shows Significance at 5% level as compared to control group (P<0.05)

The value with the different superscripts in a row are different significantly (P<0.01)

- between groups
- The value with the no superscripts in a row are having no significant relationship.

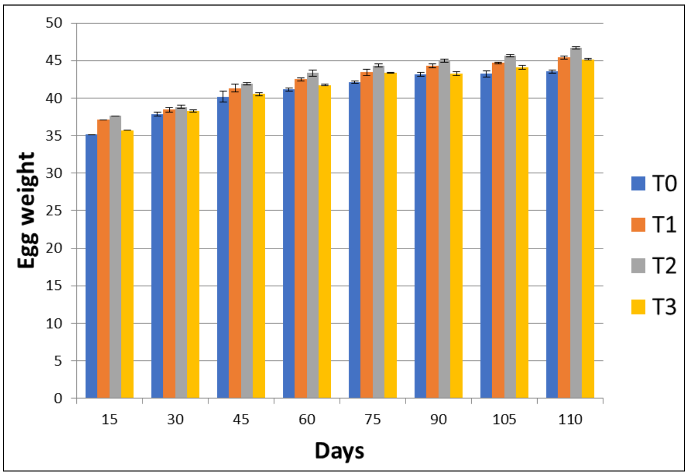

Fig 1: Graph showing effect of germinated maize on egg weight (g) in Kadaknath

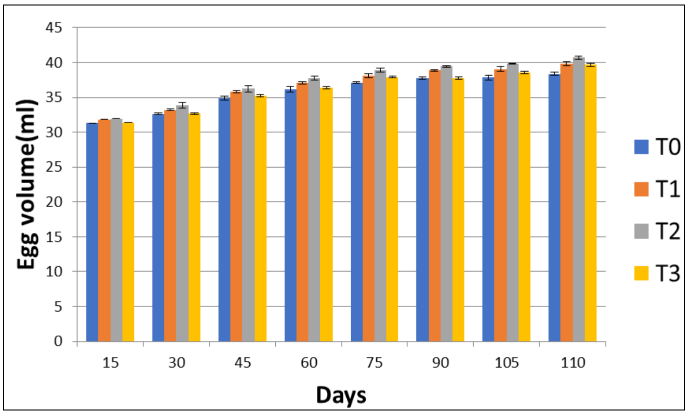

Fig 2: Graph showing effect of germinated maize on egg volume (ml) in Kadaknath

3.4 .2. Albumen volume and yolk volume

The mean values of albumen volume were 24.10±0.19, 26.25±0.18,26.80±0.25 and 25.25±0.18, after 110 days of study respectively, in T0, T1, T2 and T3 groups. There was a highly significant increase (P<0.01) in Albumen volume in treated groups as compared to control group (Table 04 and Figure 03).

The mean values of yolk volume of T0, T1, T2 and T3 were 13.90±0.17, 14.25±0.18,14.50±0.12 and 14.05±0.15, after 110 days of study, respectively. The increase was significant (P<0.05) in all treated groups as compared to control group (Table 04 and Figure 04).

Table 4: Effect of germinated maize on Egg parameters in Kadaknath layers every fortnightly after start of laying (Mean ± SE)

Albumen Volume (ml)	15 Days	30 Days	45 Days	60 Days	75 Days	90 Days	105 Days	110 Days
T0	19.15^{a} ±0.13	19. 55^{a} ±0.15	21.15^{a} ±0.13	22.15^{a} ±0.13	22.55^{a} ±0.30	23.35^{a} ±0.23	24.15^{a} ±0.13	24.10^{a} ±0.19
T1	20.40^{b} ±0.09	20.95^{bc} ±0.15	22.20^{b} ±0.16	22.75^{b} ±0.13	24.25^{b} ±0.18	25.20^{b} ±0.25	25.90^{b} ±0.30	26.25^{c} ±0.18
T2	21.10^{b} ±0.42	21.40^{c} ±0.40	22.45^{b} ±0.23	23.28^{b} ±0.12	24.50^{b} ±0.32	25.75^{b} ±0.18	26.15^{b} ±0.13	26.80^{c} ±0.25
T3	19.50^{a} ±0.12	20.25^{ab} ±0.20	21.25^{a} ±0.18	22.28^{a} ±0.14	23.15^{a} ±0.13	43.29^{a} ±0.23	24.20^{a} ±0.18	25.25^{b} ±0.18
Yolk Volume (ml)	**	**	**	**	**	**	**	**
T0	11.15^{a} ±0.13	11.40^{a} ±0.09	12.95^{a} ±0.18	13.40^{a} ±0.09	13.51^{a} ±0.27	13.60^{a} ±0.09	13.70^{a} ±0.17	13.90^{a} ±0.17
T1	11.60^{a} ±0.25	11.55^{a} ±0.18	13.20^{a} ±0.29	13.90^{b} ±0.12	13.95^{b} ±0.15	14.05^{b} ±0.15	14.15^{b} ±0.15	14.25^{b} ±0.18
T2	11.85^{b} ±0.28	12.30^{b} ±0.17	13.70^{b} ±0.19	14.05^{c} ±0.10	14.20^{c} ±0.14	14.25^{c} ±0.18	14.44^{b} ±0.18	14.50^{c} ±0.12
T3	11.30^{a} ±0.12	12.00^{b} ±0.19	13.50^{ab} ±0.19	13.85^{b} ±0.23	13.85^{b} ±0.27	13.80^{b} ±0.25	13.55^{a} ±0.13	14.05^{a} ±0.15
	*	*	*	**	**	*	*	**

**Shows Significance at 1% level as compared to control group (P<0.01)

*Shows Significance at 5% level as compared to control group (P<0.05)

* The value with the different superscripts in a row are different significantly between groups

* The value with the no superscripts in a row are having no significant relationship.

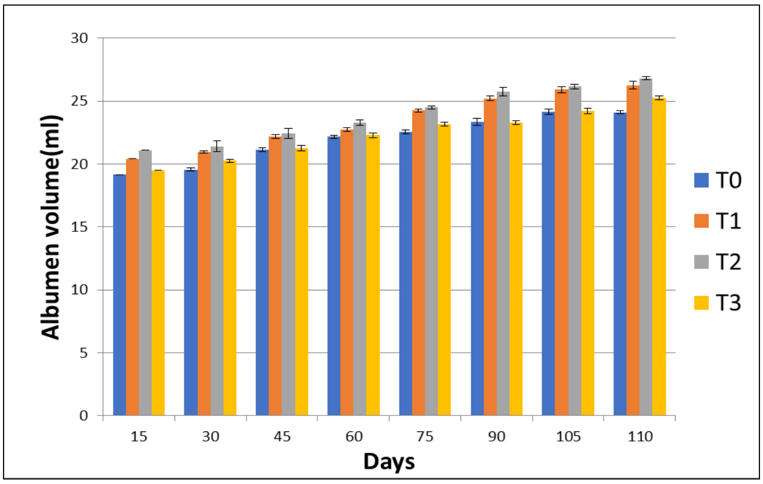

Fig 3: Graph showing effect of germinated maize on albumen volume (ml) in Kadaknath

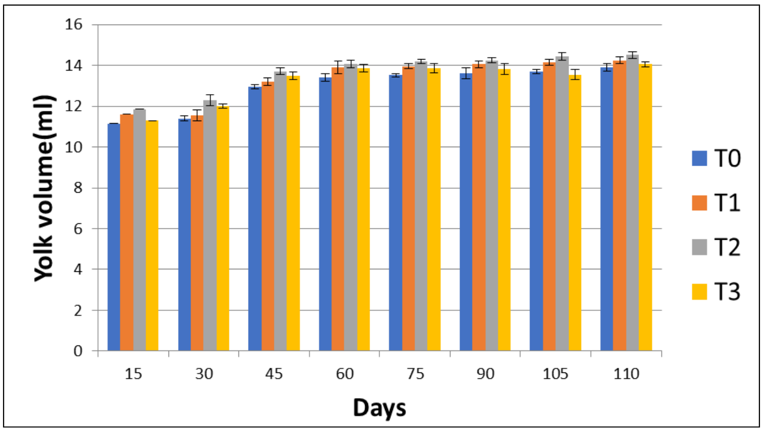

Fig 4: Graph showing effect of germinated maize on yolk volume (ml) in Kadaknath

3.4.3. Egg shell weight and egg shell thickness

The average values for egg shell weight were 5.05±0.05, 5.43±0.13,5.49±0.05 and 5.33±0.03 after 110 days of study in of T0, T1, T2 and T3, respectively. The change was found highly significant (*P*<0.01) in all treated groups as compared to control group (Table 05 and Figure 05).

The mean values for egg shell thickness of groups T0, T1, T2 and T3 were 0.79±0.05, 0.88±0.05,0.97±0.05 and 0.85±0.05, after 110 days of study, respectively,. There was a significant change (*P*<0.05) in Egg shell thickness in treated groups as compared to control group (Table 05 and Figure 06).

Table 5: Effect of germinated maize on Egg parameters in Kadaknath layers every fortnightly after start of laying (Mean ± SE)

Egg shell weight (g)	15 Days	30 Days	45 Days	60 Days	75 Days	90 Days	105 Days	110 Days
T0	4.07^{a} ±0.19	4.28^{a} ±0.15	4.50^{a} ±0.17	5.15^{a} ±0.05	4.80^{a} ±0.26	4.85^{a} ±0.09	4.95^{b} ±0.23	5.05 ±0.05
T1	4.11^{c} ±0.06	5.35^{c} ±0.08	5.11^{b} ±0.09	5.22^{a} ±0.18	5.29^{b} ±0.07	5.32^{b} ±0.07	5.38^{b} ±0.11	5.43 ±0.13
T2	4.23^{c} ±0.15	5.28 ±0.10	5.33 ±0.07	5.35^{c} ±0.08	5.40^{b} ±0.09	5.44^{c} ±0.10	5.47^{b} ±0.10	5.49^{b} ±0.05
T3	4.10^{b} ±0.12	4.45^{b} ±0.13	4.76^{b} ±0.07	4.99^{b} ±0.07	5.12 ±0.13	5.23^{b} ±0.06	5.29^{ab} ±0.03	5.33$^{a b}$ ±0.03
Egg shell thickness (g)	**	**	**	**	**	**	**	**
T0	0.45^{a} ±0.05	0.60^{a} ±0.05	0.62^{a} ±0.05	0.68^{a} ±0.05	0.70^{a} ±0.05	0.73^{a} ±0.05	0.74^{a} ±0.05	0.79^{a} ±0.05
T1	0.67^{b} ±0.05	0.73^{b} ±0.03	0.79^{b} ±0.05	0.82^{b} ±0.03	0.83^{b} ±0.05	0.83^{a} ±0.03	0.86^{b} ±0.03	0.88^{a} ±0.05
T2	0.83^{b} ±0.03	0.85^{b} ±0.05	0.86^{c} ±0.05	0.87^{c} ±0.05	0. 88^{b} ±0.05	0. 90^{b} ±0.05	0. 92^{b} ±0.05	0.97^{b} ±0.05
T3	0.59^{a} ±0.05	0.68^{a} ±0.05	0.74^{b} ±0.03	0.79^{b} ±0.05	0.80^{ab} ±0.05	0.81^{a} ±0.05	0.83^{a} ±0.05	0.85^{a} ±0.05
	*	*	**	**	*	*	*	*

**Shows Significance at 1% level as compared to control group (*P*<0.01)
*Shows Significance at 5% level as compared to control group (*P*<0.05)

- The value with the different superscripts in a row are different significantly between groups
- The value with the no superscripts in a row are having no significant relationship.

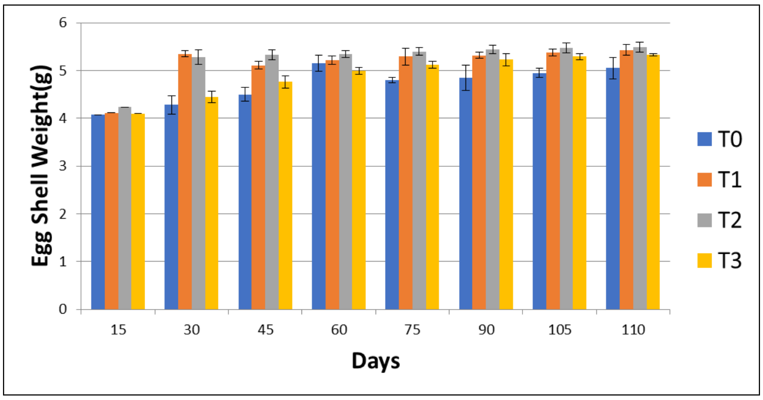

Fig 5: Graph showing effect of germinated maize on egg shell weight (g) in Kadaknath

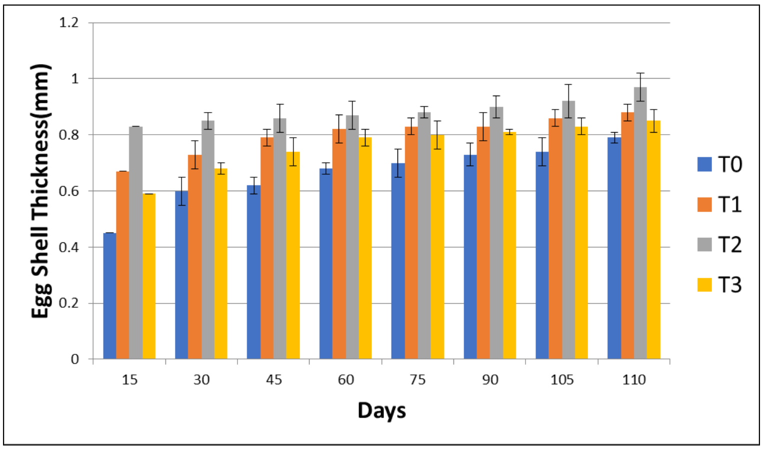

Fig 6: Graph showing effect of germinated maize on egg shell thickness (mm) in Kadaknath

3.4 .4 Economics of Kadaknath growth production

The results obtained for economics or profit per bird in all the groups in the present experiment for Kadaknath chicks are presented in Table 06 and Figure 07. The profit per bird was highest in T2 group where the germinated maize is given 75% of the cereal part as compared to other treatment groups along with control group.

Table 6: Effect of germinated maize on Economics of Egg production in Kadaknath layers in 110 days

Parameters	T0 (control)	T1	T2	T3
Age at first laying	5 months 15 days	5 months 03 days	4 months 21 days	5 months 08 days
Total egg production/ 32 Birds /110 days	896	1185	1298	1039
Total Feed Consumed/ Bird in 110 days (kg)	13.36	10.84	09.43	12.21
% Egg production	30.8	40.73	44.62	35.72
Egg production /Bird /110 days	28	37.03	40.56	32.47
Egg production /Bird /kg Feed	2.1	3.42	4.31	2.66
Feed Consumed (kg)/Dozen Eggs	5.73	3.51	2.79	4.51

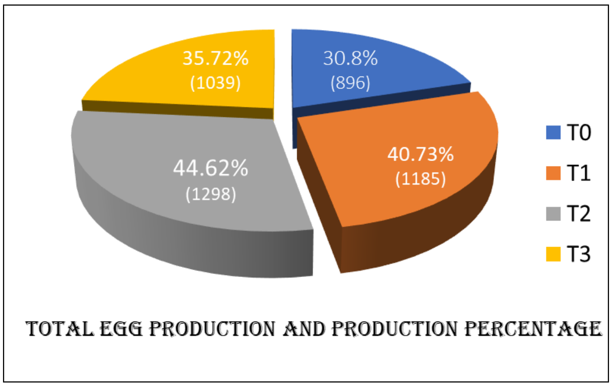

Fig 7: Graph showing effect of germinated maize on economics of egg production performance in Kadaknath

4. Discussion

Supplementation of germinated grains in rations of Kadaknath chicks in the present study gave very encouraging results regarding the growth and production. There was very much increment in body weight gain, with less feed consumption and better feed conversion efficiency of the feed after germination of maize included in the chick ration. This increase growth may be due to the increase in the activities of xylenase, phytase, β-glucanase and other enzymes like lipase, amylase, protease etc., which reduced the effects of anti nutritional factors and may increased the amino acid digestibility, absorption of minerals, carbohydrate digestibility, digestible energy of diet and ultimately the growth of chicks. The improvement in the body weight may be due to availability and utilization of nutrients from enzymatic action resulting in enhanced digestibility of nutrients and minimizing the effects of anti-nutritional factors. As sprouting may increased the concentration of certain nutrients including sugars, minerals such as phosphorus, iron, zinc, calcium and vitamins with β-glucanase increases the ME contain of feed. Sprouted grains may improve weight gain in birds. Digestibility of nutrient has been increased by using sprouted grains in the diet of broiler, layers and large animals. This may be achieved possibly by changes in rate and extent of digestion and absorption. During germination enzymes are produced which reduces viscosity of the digesta and improves the digestion and absorption of nutrients (Manwar and Mandal, 2009, Sharif *et al*., 2013) [20, 32].

The present study was in accordance with the observations recorded by Jain (2005) [15] and Tyagi *et al*., (2000) [37] after feeding phytase enzyme in the diets of WLH layers. Similar results were also shown by McDougal (2017) [21]. He gave the conclusion that feeding laying hens a diet of half sprouted barley grain and half commercial feed showed a significant increase in the total egg production. There was also a rise in the number of eggs laid compared to a diet containing only commercial feed.

The findings of the present experiment were in agreement with the observations made by Hatten *et al.* (2001) [14], Torki and Pour (2007) [35], Manwar and Mandal (2009) [20], Osman (2009) [24], Prajapati (2010) [27], Sharif *et al*. (2013) [32], Kwari *et al*. (2014) [19], Jamre (2015) [16], and Gautam (2015) [11] in broilers and Gurang and Singh (1999) [13] in Aseel, Thakur *et al.* (2006) [34] and Chatterjee *et al.* (2007) [6], and Khan *et al*. (2017) [17] in broilers, Aseel and Kadaknath. On the other hand, Fanimo and Akinola (2006) [10], Kwari *et al*. (2012) [18], Ogunfowote (2012) [23] and Torres *et al*. (2013) [36] found no signifiant change in body weights of boilers. Feed comparison and body weights may lead to the conclusion that germinated maize given in the diets of Kadaknath layers has a positive effect on the body weights and egg production. The important role of enzymes which are supplied through feed may be attributed to the fact that these enzymes act upon the feed ingredients in the gut of birds in a shorter time (Rajpoot, 2009) [28].

The present study revealed that all egg parameters *viz*. egg weight, egg volume, albumen volume, yolk volume, egg shell weight and egg shell thickness were increased significantly in all treated groups with the highest change in T2 group as compared to untreated group. These findings are in agreement with the findings of Jain (2005) [15], Parmar *et al.* (2006) [26], Afsarian *et al.* (2012) [2] and McDougal (2017) [21] for all egg parameters. On the other hand Fafiolu *et al.* (2006) [9] and Rasteh *et al.* (2017) [30] showed a negative effect on egg weight and egg parameters after germinated sorghum and barley supplementation in laying hen. The nutritional value of sprouted grain improves due to the conversion of complex compounds into simpler and essential form and by minimizing the effect of anti-nutritional factors during germination (Chavan and Kadam, 1989) [7]. Sprouting of grains can be used advantageously as it has resulted not only increased protein quantity but quality also. This is further complemented by increased sugars, certain minerals and vitamin contents. The increase in all these parameters may be due to the above factor and by this they increased the bioavailability of different minerals like calcium, phosphorus and other bi and tri- valant ions, as well as proteins and other vitamins like vit. E, which are necessary for the optimal production of good quality eggs.

Nutritional value of sprouted grain improves due to the conversion of complex compounds into simpler and essential form and by minimizing the effect of anti-nutritional factors during germination (Chavan and Kadam, 1989) [7]. Germinated maize of total grains of feed supplied to Kadaknath chicken might have developed a very good environment in digestive tract of the birds resulting into the proper digestion and utilization of nutrients so the feed efficiency of birds may increased and thus the positive effect on their production performance was clearly seen by the present experiment with the profit gain per bird without supplementation of any costly feed additive. Our findings are in close agreement with the finding of Selle *et al.* (2007) [31], Gupta *et al.* (2003) [12], Torki and Pour (2007) [35], Jain (2008) [15], Prajapati (2010) [27], Jamre (2015) [16], Gautam (2015) [11] and khan *et al.* (2018) [17]. In contrast to the results of présent study, Abbas and Musharaf (2008) [1], Osman (2009) [24], Ogunfowote (2012) [23], and Kwari *et al.* (2014) [19] reported no effect on growth parameters in broilers chicken.

5. Conclusion

The study concludes that supplementing Kadaknath bird feed with germinated maize significantly improves growth, feed consumption, production performance, and egg quality. This enhancement is attributed to the increased availability of protein, calcium, and phosphorus. The most notable benefits were observed at 50% and 75% germinated maize inclusion compared to non-germinated maize diets. Birds fed with germinated maize exhibited better overall health and productivity. This feeding strategy proves to be a highly effective approach for optimizing poultry performance. Additionally, it offers an economical solution for poultry farmers, particularly those without land. Indigenous poultry breeds, including Kadaknath, can greatly benefit from this method. The improved nutritional profile of germinated maize supports sustainable poultry farming. Its adoption can enhance livelihood opportunities for small-scale and backyard farmers. Overall, germinated maize supplementation presents a profitable and practical alternative for poultry rearing.

6. Acknowledgement

We acknowledge the administration of the College of Veterinary Sciences and A.H, Mhow and NDVSU, Jabalpur for providing all possible facilities and support to carry out this investigation easily and smoothly.

7. References

1. Abbas TEE, Musharaf NA. Effect of germination of low tannin sorghum grain on its nutrient contents and broiler chick's performance. Pak J Nutr. 2008;7(3):470-474.
2. Afsarian D, Porsadeghi M, Torki M. Effect of replacing corn with sorghum in laying hen's diets on performance and egg quality characteristics. Anim Sci J. 2012;4(93):43-49.
3. Ahuja V, editor. Livestock and Livelihoods: Challenges and Opportunities for Asia in the Emerging Market

Environment. National Dairy Development Board, India and Pro-Poor Livestock Policy Facility (South Asia Hub) of FAO; 2004.
4. Ahuja V, Sen A. Scope and Space for Small Scale Poultry Production in Developing Countries. Paper presented at: International Conference "Poultry in the 21st Century: Avian Influenza and Beyond"; 2007; Bangkok.
5. Bureau of Indian Standards (BIS). 2012.
6. Chatterjee RN, Sharma RP, Reddy MR, Niranjan M, Reddy BLN. Growth body conformation and immune responsiveness in two Indian native chicken breeds. Livest Res Rural Dev. 2007;19:151.
7. Chavan J, Kadam SS. Nutritional improvement of cereals by sprouting. Crit Rev Food Sci Nutr. 1989;28(5):401-437.
8. Dolberg F. Review of Household Poultry Production as a Tool in Poverty Reduction with Focus on Bangladesh and India. In: Ahuja V, editor. Livestock and Livelihoods: Challenges and Opportunities for Asia in the Emerging Market Environment. National Dairy Development Board, India and Pro-Poor Livestock Policy Facility (South Asia Hub) of FAO; 2004.
9. Fafiolu AO, Oduguwa OO, Ikeobi CON, Onwuka CFI. Utilization of malted sorghum sprouts in the diet of rearing pullets and laying hens. Arch Zootec. 2006;55(212):361-371.
10. Fanimo AO, Akinola OS. Response of broiler chicken to raw and processed malted sorghum sprout. Department of Animal Production and Health, University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria; 2006.
11. Gautam M. Comparative studies on growth and production performance of broilers on diets containing germinated sorghum and multienzyme complex. M.V.Sc&A.H. Thesis, Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P); 2015.
12. Gupta RK, Mohan S, Singh U, Gurung BS. Feed efficiency and carcass characteristics of Aseel chicken. Indian J Anim Sci. 2003;70(11):1170-1171.
13. Gurung BS, Singh M. Network project on survey of poultry (Aseel) genetic sciences - Terminal Report, 1996-1999.
14. Hatten LF, Ingram DR, Pittman ST. Effect of phytase on production parameters and nutrient availability in broilers and laying hens. J Appl Poult Res. 2001;10:274-278.
15. Jain A. Effect of phytase on production performance in layer birds. Indian Vet Med J. 2005;29:191-192.
16. Jamre B. Evaluation of diet containing germinated maize and multienzyme complex on growth and production performance of broilers. M.V.Sc & A.H. Thesis, Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P); 2015.
17. Khan MA, Jain A, Shakkarpude J, Mehta MK, Chauhan SS, Caesar DD. Effect of germinated maize and sorghum based diets on carcass parameters and economics production of Kadaknath. Int J Curr Microbiol Appl Sci. 2018;7(8):2385-2390.
18. Kwari ID, Diarra SS, Igwebuike JU, Nkama I, Issa S, Hamaker BR, *et al*. Replacement value of low tannin Sorghum (Sorghum bicolor) for maize in broiler chickens diet in the semi-arid zone of Nigeria. Int J Poult Sci. 2012;11:333-337.
19. Kwari ID, Igwebuike JU, Shuaibu H, Titimaand SI, Raji AO. Growth and carcass characteristics of broiler chickens fed maize, sorghum, millet and their combinations in the semi-arid zone of Nigeria. Int J Sci Nature. 2014;5(2):240-245.
20. Manwar SJ, Mandal AB. Effect of reconstitution of sorghum with or without enzymes on production performance and immunocompetence in broiler chicken. J Sci Food Agric. 2009;89(6):998-1005.
21. McDougal T. Trial reveals benefits of sprouted seeds in laying hen diets. Farmers Weekly. 2017 Jan 11. Available from: https://www.fwi.co.uk/livestock/poultry/layers/sprouted-seeds-laying-hen-diets-boost-performance.
22. Mohan J, Sastry KVH, Moudgal RP, Tyagi JS. Performance profile of Kadaknath desi hens under normal rearing system. Int J Poult Sci. 2008;43:379-381.
23. Ogunfowote AA. Comparative Effect Of Dietary Multienzymes On The Utilization Of Malted Sorghum Sprout (Msp), Hematology And Serum Parameters In Broiler Chicken. Undergraduate & Postgraduate Thesis, Federal University of Agriculture, Abeokuta; 2012.
24. Osman AHE. Effect of multi enzyme supplementation and grain source on broiler performance and carcass quality. Anim Prod Sci Technol. 2009;70:28-29.
25. Panda B, Mahapatra SC. Common breeds of poultry. In: Poultry Production. ICAR, New Delhi, India; 1989. p. 6-18.
26. Parmar SNS, Thakur MS, Tomar SS, Pillai PVA. Evaluation of egg quality traits in indigenous Kadaknath breed of poultry. Livest Res Rural Dev. 2006;18(9):1-5. Available from: http://www.lrrd.org/lrrd18/9/parm18132.htm.
27. Prajapati RS. Studies on phytase supplementation on growth performance and haemato-biochemical parameters in broilers. M.V.Sc & A.H. Thesis, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior; 2010.
28. Rajpoot JS. Comparative studies on use of multi-enzymes through drinking water and feed in broilers. M.V.Sc & A.H. Thesis, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur; 2009.
29. Rao GV, Thomas PC. The breed characteristics of Kadaknath breed of indigenous (Desi) chicken. Avian Res. 1984; 68:55-57.
30. Rasteh MR, Dastar B, Shargh MS, Zerehdaran S, Ashayerizadeh O. Effect of Different Levels of Germinated Barley on Performance and Egg Quality in Laying Hen. Int J Adv Biol Biomed Res. 2016;4(2):117-125.
31. Selle PH, Ravindran V, Ravindran G, Bryden WL. Effect of dietary lysine and microbial phytase on growth performance and nutrient utilization of broiler chickens. Asian-Australas J Anim Sci. 2007;20:1100-1107.
32. Sharif M, Hussain A, Subhani M. Use of sprouted grains in the diets of poultry and ruminants. Indian J Res. 2013;2(10):4-7.
33. Snedecor GW, Cochran WG. Statistical Methods. 8th

ed. Ames, Iowa: Iowa State University Press; 1994. 503 p.
34. Thakur MS, Parmar SNS, Pillai PVA. Studies on growth performance in Kadaknath breed of poultry. Livest Res Rural Dev. 2006; 18(8):1-9. Available from: http://www.lrrd.cipav.org.co/lrrd18/8/thak18116.htm.
35. Torki M, Pour MF. Use of dietary enzyme inclusion and seed germination to improve feeding value of sorghum for broiler chicks. 16th European Symposium on Poultry Nutrition; 2007. p. 643-646.
36. Torres KAA, Pizauro JM, Soares CP, Silva TGA, Nogueira WCL, Campos DMB, *et al*. Effects of corn replacement by sorghum in broiler diets on performance and intestinal mucosa integrity. J Poult Sci. 2013;92:1564-1571.
37. Tyagi PK, Tyagi PK, Verma SVS. Influence of dietary non-phytate phosphorus and supplemental phytase on the performance and egg quality of laying hens. XX Annual Conference and Symposium of Indian Poultry Science Association; 2000 Oct 12-14; Chennai. p. 113.