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Effect of feeding Azolla (*Azolla pinnata*) leaf powder on nutrient utilization in turkey poults

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Abstract
The goal of the current study was to evaluate the "Effect of feeding Azolla (*Azolla pinnata*) leaf powder on nutrient utilization in turkey poults (*Meleagris gallapavo*)". One hundred and twenty-eight turkey poults (day-old) were randomly divided into four treatments with four replicates and 8 poults each for a period of 8 weeks. Control group (T_1) was fed on a basal diet without Azolla supplementation and three experimental diets were prepared by replacing the basal diet with azolla meal at 2.5% (T_2), 5% (T_3) and 7.5% (T_4) levels. According to the findings of this experiment into nutrient usage, Azolla-supplemented groups utilized nutrients more effectively than control diet groups in terms of per cent DM, CP, EE, CF, NFE and energy balance. The results of this study showed that turkey poults between the ages of 0-8 weeks had better nutrient utilization when Azolla leaf powder up to 7.5% level was added to the diet as a supplement.

Keywords: Azolla meal, utilization, Turkey, intake and digestibility

Introduction
Next to chicken, duck, guinea fowl, and quail, turkey holds a significant position in the fastest-evolving industry, which is significantly improving the economic and nutritional situation of a diverse population. They make up roughly 2% of the entire poultry population. They are raised exclusively for their flesh, which is the leanest of all domesticated avian species. Turkeys are mainly seen in modest concentrations in and around India's cosmopolitan cities. In Kerala, Tamil Nadu, the eastern portions of Uttar Pradesh, among other places in India, native and nondescript turkeys are plentiful. Country like India is quite suitable for Turkey farming. It may successfully increase the economy of marginal and small farmers. Turkey can be easily reared in semi-intensive and free-range housing system with lowest input for their care and management. Currently, Turkey industry is growing rapidly in the agriculture sector. Turkey is a quickly growing bird. It required more energy, minerals, vitamins and proteins as compared to chicken for quick growth. Due to their growing habits, aquatic plants have a larger potential than tree leaves as a protein source for monogastric animals because they do not accumulate secondary plant components (Bacerra *et al*. 1995) [3]. Aquatic plants provide an affordable alternative to animal feed and have a wide range of possible uses, including compost, bio-fertilizers, human food, and animal feed (Balaji *et al*. 2009) [4]. From the standpoint of ease of culture, productivity, and nutritional value, the water fern Azolla (*Anabaena azollae*) is possibly the most promising (Lumpkin and Plucknette, 1982) [9].

Methods and Materials
Experimental diets and design
To determine the impact of including Azolla leaf (ALP) powder in the diet of young turkeys, a feeding trial lasting eight weeks (0-8) was carried out. Day-old turkey poults (n = 128) were randomly assigned to four dietary treatments (one control + three test diets) in a biological experiment. Each treatment had four repetitions of eight turkey poults, which allowed for a total of 32 poults in each treatment.

Statistical analysis
The experimental design used a completely randomized design (CRD), Snedecor and Cochran's (1994) [17].

Description of analysis of variance was used to examine the data pertaining to various parameters that were gathered during the current study.

Results and Discussion

Nutrient composition of azolla leaf powder

The data revealed that Azolla leaf powder (ALP) contained 95.70, 27.00, 14.70, 3.70 33.84 and 16.46 per cent of dry matter, crude protein, crude fibre, ether extract, nitrogen-free extract and total ash, respectively which is closely in agreement with the findings of Shukla *et al*. (2018) [16] who reported dry matter content closely to current value. However, the current results were contradicted with Sharma *et al*. (2020) [14]. Who reported 89.70 to 92.16 per cent of dry matter, which was lower than current findings. The crude protein (CP) content in Azolla leaf powder was 27.00 per cent in current study which was closely related to the findings of Shukla *et al*. (2018) [16], Bhattacharya *et al*. (2016) [5], Shamna *et al*. (2013) [13] and Basak *et al*. (2002) [6] who reported CP content of 25-26 per cent. The crude fibre (CF) value was 14.70 per cent in current study which was similar with the findings of Cherryl *et al*. (2014) [7]. Whereas, the findings of present study were contradicted with the results of Shukla *et al*. (2018) [16], Shinde *et al*. (2017) [15] and Basak *et al*. (2002) [6] who reported 15.05 to 17.29 per cent CF. The value of ether extract (EE) was 3.70 per cent which was found similar to Cherryl *et al*. (2014) [7] and Balaji *et al*. (2009) [4]. Sharma *et al*. (2020) [14] reported 40.37 per cent nitrogen-free extract in Azolla which was higher than current findings. Total ash content was 16.46 per cent in the present findings which was closely similar to Shinde *et al.* (2017) [15] and contradicted with findings of Mishra *et al.* (2016) [10] and Cherryl *et al.* (2014) [7].

Nutrient utilization

The information on nutrient usage is shown in Table 1. Intake of dry matter (DMI) in Turkey poults was found to be significantly lowest in T_1 (70.09±0.80) as compared to rest of the treatments. The difference in DMI among T_2 (76.27±1.20), T_3 (77.11±0.48) and T4 (78.36±0.96) g per poults per day was small and found non-significant. The data revealed that the highest digestible DMI was observed in T_4 (58.13±0.82) and T_3 (58.02±0.51) followed by T_2 (55.43±0.95) and significantly lowest digestible DMI was found in T_1 (49.42±0.90). The difference in digestible DMI between T_3 and T_4 was found statistically non-significant. The CPI intake was significantly lowest in T_1 (18.15±0.21) as compared to the rest of the treatment groups. The difference in CPI among T_2, T_3 and T_4 were found statistically non-significant. The digestible CPI was observed to be significantly higher in T_3 (14.58±0.08) and T_4 (14.26±0.27) followed by T_2 (13.35±0.27) and significantly lowest digestible CPI was found in T_1 (11.88±0.21). The difference between T_3 and T_4 was found statistically non-significant. The ether extract intake (EEI) was significantly lowest in T_1 (2.21±0.03g) as compared to the rest of the treatment groups. Significantly highest (2.52±0.03g) EEI was found in T_4 as compared to rest of the treatment groups except T_3. However, the difference between T_2 and T_3 was statistically non-significant. The digestible EEI was significantly lowest in T_1 (1.75±0.03 g) as compared to rest of the treatment groups, while the difference among T_2 (1.95±0.04), T_3 (2.02±0.01) and T_4 (1.99±0.02 g) were small and statistically non-significant. Crude fibre intake (CFI) ranged from 3.15±0.04 to 4.04±0.05 g among different treatment groups. Significantly highest CFI was observed in T_4 (4.04±0.05 g) followed by T_3 (3.81±0.02 g), T_2 (3.60±0.06 g) and significantly lowest crude fibre intake was observed in T_1 (3.15±0.04 g). The digestible CFI was significantly lowest digestible CFI was observed in T_1 (1.96±0.05 g) as compared to rest of the treatment groups. Significantly highest digestible CFI was found in T_3 and T_4 at 2.67±0.03 and 2.73±0.07 g, respectively as compared to rest of the treatment groups. However, the difference between T_3 and T_4 was found non-significant. Nitrogen-free extract intake (NFEI) was significantly lowest was observed in T_1 (34.06±0.39) as compared to rest of the treatment groups. However, the difference among T_2, T_3 and T_4 were found non-significant. Digestible NFE intake was significantly lowest in T_1 (22.30±0.41 g), and significantly highest in T_3 and T_4 at 25.19±0.04 and 25.13±0.14 g, respectively. The difference between T_3 and T_4 was small and found statistically non-significant. Significantly lowest nitrogen intake was found in T_1 (2.90±0.03 g). However, the difference in nitrogen balance among T_2, T_3 and T_4 were small and found statistically non-significant. Nitrogen balance was significantly highest nitrogen balance was observed in T_3 and T_4 at 2.33±0.01 and 2.28±0.04 g, respectively followed by T_2 (2.14±0.04 g) and significantly lowest nitrogen balance was observed in T_1 (1.90±0.03 g). The difference between T_3 and T_4 was found statistically non-significant. Gross energy intake was observed significantly lowest in T_1 (200.04±2.27) as compared to rest of the treatment groups. The difference in gross energy intake among T_2 (217.33±3.42), T_3 (219.29±1.37) and T_4 (222.62±2.73) were found statistically non-significant. Gross energy balance was observed significantly lowest gross energy intake was in T_1 (122.23±3.69) in comparison to the remaining treatment groups. The difference in gross energy balance among T_2 (142.06±2.72), T_3 (146.17±1.32) and T_4 (145.67±2.52 g) were found statistically non-significant.

Table 1: Effect of feeding Azolla leaf powder on nutrient intake (g/birds/day) and nutrient utilization in turkey poults

Parameter/Treatments	T_1	T_2	T_3	T_4	S.Em±	CD at 5%
DMI (g/bird/day)	70.09±0.80^b	76.27±1.20^a	77.11±0.48^a	78.36±0.96^a	0.69	2.13
Digestible DM intake (g/bird/day)	49.42±0.90^c	55.43±0.95^b	58.02±0.51^a	58.13±0.82^a	0.57	1.75
CPI (g/bird/day)	18.15±0.21^b	19.74±0.31^a	19.97±0.13^a	20.22±0.25^a	0.18	0.55
Digestible CP intake (g/bird/day)	11.88±0.21^c	13.35±0.27^b	14.58±0.08^a	14.26±0.27^a	0.19	0.60
EEI (g/bird/day)	2.21±0.03^c	2.43±0.04^b	2.46±0.02^{ab}	2.52±0.03^a	0.02	0.07
Digestible EE intake (g/bird/day)	1.75±0.03^b	1.95±0.04^a	2.02±0.01^a	1.99±0.02^a	0.03	0.08
CFI (g/bird/day)	3.15±0.04^d	3.60±0.06^c	3.81±0.02^b	4.04±0.05^a	0.03	0.10
Digestible CF intake (g/bird/day)	1.96±0.05^c	2.31±0.05^b	2.67±0.03^a	2.73±0.07^a	0.05	0.14
NFEI (g/bird/day)	34.06±0.39^b	36.79±0.58^a	36.89±0.23^a	37.27±0.46^a	0.33	1.03
Digestible NFE intake (g/bird/day)	22.30±0.41^c	23.63±0.34^b	25.19±0.04^a	25.13±0.14^a	0.22	0.69
N intake (g/bird/day)	2.90±0.03^b	3.16±0.05^a	3.20±0.02^a	3.24±0.04^a	0.03	0.09
N balance	1.90±0.03^c	2.14±0.04^b	2.33±0.01^a	2.28±0.04^a	0.03	0.10
GE intake (g/bird/day)	200.04±2.27^b	217.33±3.42^a	219.29±1.37^a	222.62±2.73^a	1.97	6.07
GE balance	122.23±3.69^b	142.06±2.72^a	146.17±1.32^a	145.67±2.52^a	2.52	7.75

Means with the same superscripts in a particular row do not differ significantly ($p<0.05$) from each other.

The data pertaining to the digestibility coefficient of nutrients are tabulated in Table-2. Significantly highest digestibility coefficient was observed in T3 (75.25±0.43%) followed by T_4 (74.19±0.42%), T_2 (72.67±0.33%) and significantly lowest digestibility coefficient was observed in T_1 (70.49±0.54%). Crude protein digestibility ranged from 65.46±0.48 to 73.02±0.73 per cent between various treatment groups. There was a noticeably greater digestibility coefficient in T_3 (73.02±0.73%) followed by T_4 (70.50±0.70%), T_2 (67.60±0.55%) and significantly lowest in T_1 (65.46±0.48%). Significantly highest ether extract digestibility was observed in T_3 as compared to rest of the treatment groups except T_2. However, it was shown that the difference between T_2 and T_3 and between T_1, T_2, and T_4 was statistically insignificant. Significantly highest digestibility coefficient of crude fibre was found in T_3 compared to the other treatment groups, with the exception of T_4. Significantly lowest value was noted in T_1 as compared to the rest of the treatment groups except T_2. The difference between T_1 and T_2; T_2 and T_4 and T_3 and T_4 were found statistically non-significant. The digestibility coefficient of nitrogen-free extract was statistically higher in T_3 and T_4 as compared to T_1 and T_2. It was determined that there was no statistically significant difference between T_1 and T_2, nor between T_3 and T_4.

Table 2: Effect of feeding Azolla leaf powder on digestibility coefficient of nutrients in turkey poults

Parameter/Treatments	T_1	T_2	T_3	T_4	S.Em	CD at 5%
DM digestibility (%)	$70.49±0.54^d$	$72.67±0.33^c$	$75.25±0.43^a$	$74.19±0.42^b$	0.30	0.91
CP digestibility (%)	$65.46±0.48^d$	$67.60±0.55^c$	$73.02±0.73^a$	$70.50±0.70^b$	0.58	1.77
EE digestibility (%)	$79.08±0.90^b$	$80.33±0.42^{ab}$	$82.27±0.30^a$	$79.01±1.11^b$	0.67	2.08
CF digestibility (%)	$62.27±2.03^c$	$64.19±0.83^{bc}$	$70.14±0.41^a$	$67.55±0.97^{ab}$	1.14	3.53
NFE digestibility (%)	$65.46±0.51^b$	$64.23±0.37^b$	$68.29±0.42^a$	$67.44±0.64^a$	0.43	1.34

Means with the same superscripts in a particular row do not differ significantly ($p<0.05$) from each other.

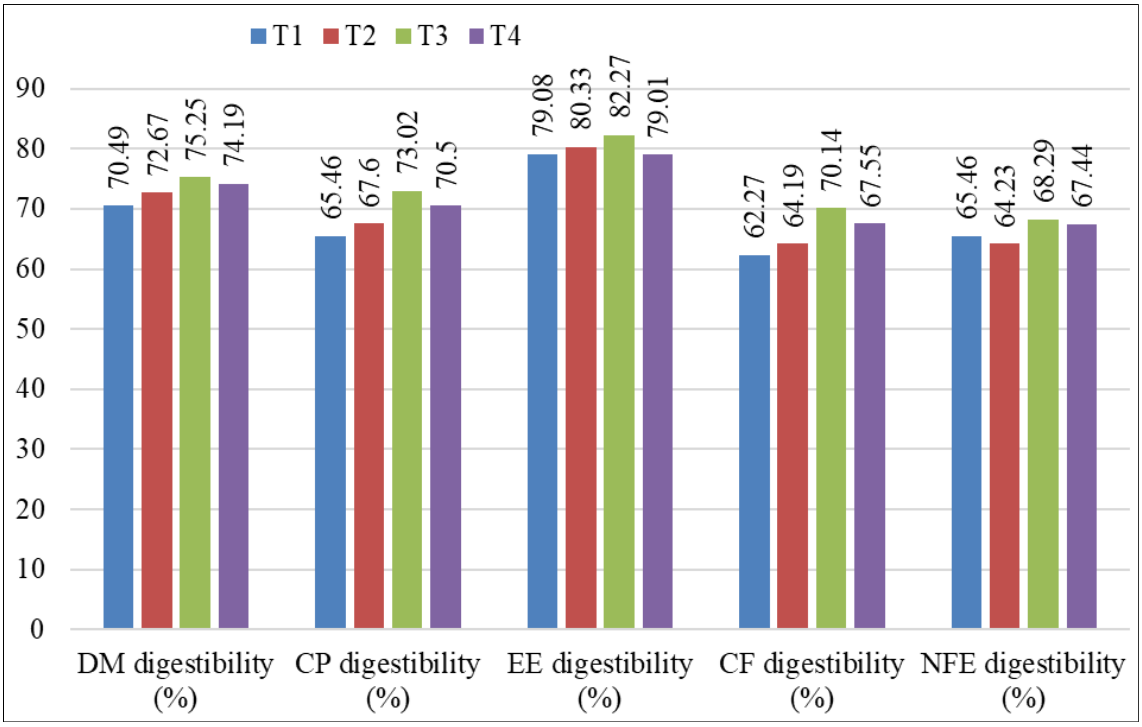

Fig 1: Effect of feeding Azolla leaf powder on digestibility coefficient of nutrients in turkey poults

According to the study's findings, T_3 birds fed diets containing 5% ALP had considerably greater DM, CP, CF, EE, and NFE digestibility coefficients than the other treatment groups. The statistically lowest N balance was reported in T_1, and the differences between T_2, T_3, and T_4 were not found to be significant. Similar to this, the GE balance was considerably lowest in T_1 and the differences between T_2, T_3, and T_4 were not significant. The findings of the present study concur with those of Abdelatty *et al.* (2020) [1], who found that digestibility tended to rise linearly as ALM increased. According to Samad *et al.* (2020) [12], feeding Azolla at 10% and 15% improved nutritional digestibility significantly. According to Mishra *et al.* (2016) [10], retentions of crude protein and calcium were higher in Azolla-fed groups compared to the control, and retentions of phosphorus and dry matter were equivalent across all groups in terms of their ability to be metabolized. Similar to this, Rathod *et al.* (2013) [11] found that AZM-fed groups utilized nutrients more efficiently than control groups in terms of DM Metabolizability, nitrogen, calcium, and phosphorus retention (%). However, according to Kumar *et al.* (2018) [8], AZM had no impact on DM digestibility, N intake, or N retention. However, nitrogen balance was discovered to be positive in a variety of treatment groups, which is consistent with the findings of the current investigation. Similar findings were found by Rana *et al.* (2017) regarding the nitrogen balance and dry matter digestibility of the groups.

Conclusion

By comparing the results of the current study to the control group, it can be deduced that turkey poults given experimental diets containing Azolla attained high values of nutritional digestibility.

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