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Effect of feeding poultry litter waste on liver health of crossbred dairy cows

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Abstract
In the current investigation, a total of 24 lactating animals, seven days after calving, were meticulously selected and subsequently divided into four distinct groups, namely T_0 - Control (Concentrate), T_1 - Concentrate replaced with 10 percent poultry litter waste, T_2 - Concentrate replaced with 20 percent poultry litter waste, and T_3 - Concentrate replaced with 30 percent poultry litter waste. Upon conducting this thorough study, it was revealed that the average alkaline phosphatase levels were found to be within the range of 21.25 to 38.75 during the winter season and 28.09 to 38.50 (IU/dL) during summer season, respectively. Furthermore, it is important to note that these results were found to be non-significant (p>0.05) throughout the entirety of the experiment. The Alanine transaminase (ALT), aspartate aminotransferase (AST), and bilirubin range were also meticulously analyzed during the winter season, where the results indicated that the levels ranged from 27.65 to 34.47 (IU/dL), 58.64 to 80.96 (IU/dL), and 0.14 to 0.21 (mg/dL), respectively. Similarly, during summer season, the levels of ALT, AST, and bilirubin ranged from 33.70 to 39.50 (IU/dL), 83.39 to 110.07 (IU/dL), and 0.12 (mg/dL), respectively. It is imperative to note that the ALP, ALT, AST, and bilirubin levels observed in both seasons were found to remain within the normal range.

Keywords: Crossbreed dairy cows, poultry litter waste, summer and winter season

Introduction
The poultry industry in India is a crucial segment of livestock production and has witnessed remarkable growth over the years. Figures from the Livestock Census revealed a 16.81% increase in the total poultry population in 2019, reaching a staggering 851.81 million from the 729.21 million recorded in 2012 (Livestock Census, 2019) [1]. Consequently, the production of poultry manure has also risen in tandem with population growth. In India, the poultry farming system generates a substantial amount of waste, with 38.33 million MT of poultry manure, 9486 MT of hatchery waste, and 1.74 million MT of slaughterhouse wastes produced during the 2018-2019 period alone (Prabakaran & Valavan, 2021) [12]. This situation calls for a comprehensive waste management approach to mitigate the environmental impact of the waste. Research estimates that commercial farms produce between 1.1 to 2.4 MT of dried manure for chickens, 7.3 to 12.7 MT for turkeys, and 3.9 MT for ducks per 1000 birds up to market age (Collins *et al.*, 1999) [7].

India is the global leader in buffalo population and second position in cattle population. According to the 2019 census, the total livestock population in the country was 535.78 million. The cattle population in India stood at 192.49 million, which is an increase of 0.8% from the previous survey. The 2019 census also revealed that the milch exotic-crossbreed cattle population was 25.67 million, indicating a substantial increase of 32.2% compared to the previous survey (Livestock Census, 2019) [1]. The rise in livestock population has led to a decrease in fodder production and grazing land, resulting in increased dependency on alternative feed sources, highlighting the need for sustainable livestock production practices.

The productivity of dairy cows can be attributed to their genetic composition by only 30%. The remaining 70% is largely dependent on multiple factors such as nutrition, appropriate supplementary diets, and effective management practices, as stated by Abdi *et al.* (2022) [2].

Poultry litter waste contains various amounts of nutrients and these nutrients can be affected animals' health. However, dried poultry manure waste contains a substantial amount of digestible energy, crude protein, crude fat, crude fiber, cobalt, iodine, and other nutrients that enable ruminants to utilize the urea nitrogen of poultry and convert it into production (Ghaly and Macdonald, 2012) [9].

Consequently, poultry manure waste is readily available at a lower cost than other sources of feed offered to livestock, making it an attractive option for livestock farmers. Despite its potential benefits, the use of poultry manure waste in livestock feed is still underexplored. Therefore, this was undertaken to know the effect of feeding poultry litter waste on different parameters of livers during winter and summer seasons.

Material and Methods

After a period of seven days following parturition, a total of 24 lactating crossbreed cows with comparable lactation statuses were carefully selected for the purpose of this particular study. The selected cows were accommodated in a well-ventilated shelter, which had a concrete floor, situated at the Instructional dairy farm Nagla, College of Veterinary and Animal Science, Pantnagar, Uttarakhand, India. These cows were subsequently divided into four groups, each comprising six animals that were not significantly different in terms of weight and initial milk production. These groups were designated by the following names: T_0 - Control (Concentrate fed as per the requirements), T_1 - concentrate replaced with 10 percent poultry litter waste, T_2 - concentrate replaced with 20 percent poultry litter waste, and T_3 - concentrate replaced with 30 percent poultry litter waste. The concentrate was administered with or without poultry litter waste to the groups during milking times at 4.00 A.M. and 4.00 P.M. for a duration of 120 days, which took place between November 2021 to February 2022 in the winter season and March and June as the summer season.

The blood collection was done at the start of the experiment and after that for 30 days, 60 days, 90 days, and at the end of the experiment 120 days from the 24 lactating crossbred cows. Collected blood was transferred to vials for serum separation and subsequently analyzed using IBM SPSS 21.0.

The analysis of serum alkaline phosphatase (ALP), serum alanine aminotransferase (ALT), and serum aspartate aminotransferase (AST) concentration (U/L) was determined using the ERBA diagnostic kit based on the method provided by the International Federation of Clinical Chemistry (IFCC) as described by Tietz (1986) [13] and Bradley *et al.* (1972) [6]. The concentration of total bilirubin in the serum samples was determined using the ERBA diagnostic kit, which is based on the diazo method developed by Tietz (1986) [13].

Results

Liver function test

Liver function tests play a critical role in assessing the health status of crossbreed dairy cows when exposed to alternate diets, such as poultry litter waste. These tests, which include ALP (alkaline phosphatase), ALT (alanine transaminase), AST (aspartate transaminase), and bilirubin levels, offer a window into the metabolic processes of the liver and its overall well-being. Monitoring these parameters becomes especially crucial when cows are subjected to poultry litter waste, which can potentially pose a threat to their liver health. Regular evaluation of these liver markers can facilitate early identification of any adverse effects caused by non-traditional diets, ensuring timely interventions to maintain the health and productivity of dairy cows.

Alkaline phosphatase (ALP)

The average alkaline phosphatase (ALP) levels in crossbred dairy cows resulting from the feeding of poultry litter waste during the winter season were presented in Table 1 and during the summer season in Table 2. The ALP levels at days 0, 30, 60, 90, and 120 in different groups, namely T_0, T_1, T_2, and T_3 did not show any significant differences among each other during both seasons. The ALP levels observed in both seasons remained within the normal range, as mentioned in the Merck Veterinary Manual (2010) [11] and Aggarwal *et al.* (2016) [3]. Suggested that high-quality protein was provided in the diet of the experimental animals, as reported by Akinmutimi (2004) [4]. Bello and Tsado (2013) [5] also obtained similar results, where ALP levels showed no significant differences in rams fed with diets containing 0%, 20%, 40%, 60%, and 80% maize beans replaced with poultry droppings.

Table 1: Effect of feeding poultry litter waste on a liver functional test of crossbred dairy cows during the winter season

Parameters	Days	T_0	T_1	T_2	T_3	SEm±	Sig. 5%
ALP (IU/dL)	0	21.25±1.29	21.66±1.18	22.21±0.99	22.15±1.41	0.058	0.939
	30	35.86±2.20	38.75±0.69	38.46±1.24	36.92±1.00	0.698	0.446
	60	28.17±1.33	26.51±1.29	28.63±1.25	26.92±2.19	0.754	0.747
	90	26.02±1.54	25.11±1.23	27.86±3.97	28.78±2.05	1.179	0.708
	120	24.47±1.23	23.68±0.91	25.66±1.39	26.39±0.97	0.578	0.370
ALT (IU/dL)	0	29.34±1.98	27.65±3.08	28.10±1.79	28.17±2.25	1.095	0.961
	30	29.35±1.91	29.63±3.05	32.29±1.96	31.74±2.79	1.187	0.786
	60	32.71±0.94	34.5±1.60	34.47±0.58	31.44±2.38	0.767	0.446
	90	25.53±5.16	32.00±1.86	32.81±1.36	32.20±2.06	1.533	0.306
	120	30.93±0.76	31.73±1.77	31.04±0.67	32.15±0.52	0.503	0.827
AST (IU/dL)	0	69.33±2.27	68.60±2.80	69.84±3.04	58.64±11.84	3.124	0.563
	30	78.45±2.44	76.33±4.00	80.96±4.13	79.62±4.44	1.822	0.852
	60	75.88±1.09	76.69±1.99	79.72±3.02	74.15±3.02	1.204	0.448
	90	70.50±3.45	73.09±1.45	76.95±3.34	71.38±1.16	1.308	0.326
	120	64.11±2.38	68.72±1.57	67.82±2.68	66.3±2.60	1.155	0.542
Bilirubin (mg/dL)	0	0.20±0.01	0.21±0.00	0.20±0.01	0.20±0.00	0.006	0.955
	30	0.19±0.01	0.18±0.01	0.17±0.01	0.19±0.00	0.005	0.494
	60	0.19±0.02	0.19±0.01	0.18±0.01	0.21±0.00	0.007	0.551
	90	0.19±0.02	0.16±0.00	0.17±0.01	0.17±0.01	0.007	0.444
	120	0.12±0.00	0.12±0.00	0.13±0.00	0.14±0.00	0.003	0.198

ALP- Alkaline phosphatase, ALT- Alanine transaminase, AST- Aspartate aminotransferase.

Table 2: Effect of poultry litter waste on liver functional test values of crossbred dairy cows during the summer season

Parameters	Days	T_0	T_1	T_2	T_3	SEm±	Sig. 5%
ALP (IU/dL)	0	29.79±1.55	28.09±1.25	32.91±2.61	31.92±1.37	0.917	0.252
	30	34.24±1.58	36.35±1.28	35.46±2.43	38.50±2.17	0.954	0.472
	60	30.09±1.60	28.98±1.30	27.84±5.68	32.56±1.87	1.521	0.752
	90	29.76±1.28	30.62±1.09	31.2±1.75	31.59±2.02	0.752	0.858
	120	28.19±1.09	30.20±0.89	31.41±1.6	31.26±0.91	0.605	0.216
ALT (IU/dL)	0	35.10±2.71	34.80±2.58	35.77±2.98	34.55±2.81	1.298	0.991
	30	35.64±1.32	36.33±2.04	36.05±2.17	37.91±0.83	0.830	0.808
	60	34.83±0.57	36.50±0.99	36.73±1.72	38.31±2.01	0.720	0.426
	90	33.70±1.96	35.32±2.78	36.54±2.45	38.19±2.65	1.207	0.632
	120	35.39±1.05	36.57±1.64	38.34±1.71	39.50±1.84	0.814	0.298
AST (IU/dL)	0	86.57±5.10	91.81±6.19	83.39±9.29	86.31±6.00	3.250	0.852
	30	99.12±2.22	104.84±4.56	105.2±5.46	101.01±5.12	2.177	0.734
	60	100.4±1.27	110.07±6.14	103.96±5.29	108.62±3.15	2.199	0.408
	90	92.68±2.46	100.26±2.51	95.11±4.03	99.27±2.35	1.508	0.252
	120	94.08±2.86	105.8±5.45	97.52±8.1	104.69±6.25	2.965	0.461
Bilirubin (mg/dL)	0	0.20±0.00	0.20±0.00	0.21±0.01	0.20±0.01	0.005	0.934
	30	0.20±0.01	0.18±0.01	0.18±0.01	0.17±0.01	0.007	0.601
	60	0.17±0.02	0.18±0.00	0.16±0.00	0.17±0.00	0.005	0.800
	90	0.13±0.00	0.13±0.01	0.14±0.00	0.16±0.01	0.005	0.230
	120	0.12±0.00	0.12±0.01	0.13±0.01	0.16±0.01	0.006	0.174

Alanine transaminase (ALT)

The average alanine aminotransferase (ALT) levels in crossbred dairy cows resulting from the feeding of poultry litter waste during the winter season were presented in Table 1. The ALT levels in different groups, namely T_0, T_1, T_2, and T_3, did not show any significant differences at days 0, 30, 60, 90, and 120 during the winter season. The average ALT values in crossbred dairy cows resulting from the feeding of poultry litter waste during the summer season were presented in Table 2. The average ALT values on the 0^{th}, 30^{th}, 60^{th}, 90^{th}, and 120^{th} day of the experiment showed no significant differences (p>0.05) with both the control and treatment groups.

The ALT levels observed in both seasons fell within the normal range, as mentioned in the Merck Veterinary Manual (2010) [11] and supported by Aggarwal *et al.* (2016) [3]. Bello and Tsado (2013) [5] also obtained similar results, where ALT levels showed no significant differences in rams fed with diets containing 0%, 20%, 40%, 60%, and 80% maize bran replaced with poultry droppings. According to Mansilla *et al.* (2023) [10], the reference range for SGPT (Serum Glutamate Pyruvate Transaminase) in dairy cattle is reported to be between 11 to 40 IU/dL.

Aspartate aminotransferase (AST)

The average aspartate aminotransferase (AST) levels in crossbred dairy cows resulting from the feeding of poultry litter waste during the winter season were presented in Table 2, and during the summer season in Table 2. The AST levels at days 0, 30, 60, 90, and 120 in different groups, namely T_0, T_1, T_2, and T_3, did not show any significant differences (p>0.05) among each other during both seasons. The AST levels observed in both seasons fell within the normal range, as mentioned in the Merck Veterinary Manual (2010) [11] and supported by Aggarwal *et al.* (2016) [3]. The fact that the observed values were within the normal range indicates that the poultry litter waste provided a good dietary protein source, as elevated levels of serum glutamic oxaloacetic transaminase (SGOT) can indicate liver diseases or necrosis resulting from poor-quality protein inclusion in the animals' diet (Fasina *et al.* 1999) [8]. Bello and Tsado (2013) [5] also obtained similar results, where AST levels showed no significant differences in rams fed with diets containing 0%, 20%, 40%, 60%, and 80% maize bran replaced with poultry droppings. According to Mansilla *et al.* (2023) [10], a higher reference range for SGOT in dairy cattle is to be between 78 to 132 IU/dL.

Bilirubin

The average bilirubin levels in crossbred dairy cows resulting from the feeding of poultry litter waste during the winter season were presented in Table 1 and during summer were presented in Table 2. The bilirubin levels in different groups, namely T_0, T_1, T_2, and T_3, at days 0, 30, 60, 90, and 120, did not show any significant differences (p>0.05) among each other during both seasons winter and summer seasons. The results of the present study indicate that there was no significant effect of feeding poultry litter waste to crossbred dairy cows during the winter and summer seasons. The bilirubin levels observed in both seasons fell within the normal range, as mentioned in the Merck Veterinary Manual (2010) [11]. The study conducted by Mansilla *et al.* (2023) [10] did not have a notable impact on liver function as measured by bilirubin concentration in dairy cattle.

Conclusion

The present investigation's recent findings suggest that the addition of poultry litter in the diet of crossbreed dairy cows, substituting the concentrate with 10%, 20%, and 30%, does not have any influence on the alkaline phosphatase, alanine transaminase, aspartate aminotransferase, and bilirubin throughout all treatment groups in both summer and winter seasons. This can be attributed to the fact that the utilization of poultry litter waste in animal feed does not have any harmful effect on liver function. Hence, it can be inferred that the incorporation of poultry litter in dairy cow feed can be a sustainable and cost-effective alternative feed source.

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