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Incorporation of Dry Sugar Beet Pulp with and Without Enzymes in Broiler Diets: A Sustainable Alternative for Cost-effective Poultry Production

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ABSTRACT

This research aimed to evaluate the feasibility of incorporating dry sugar beet pulp (DSBP) as a partial replacement for conventional feed ingredients in broiler diets, with a focus on its effects growth metrics, nutrient utilization, blood biochemical profiles, carcass characteristics, and economic efficiency. A total of 216-day-old Vencobb-430 broiler chicks were randomly distributed into six dietary groups, each with three replicates. The experimental design included diets containing 0%, 4%, and 8% DSBP, either with or without exogenous enzyme supplementation. Feeding was structured across three phases: starter, grower, and finisher. Parameters such as feed intake, body weight gain, and feed conversion ratio (FCR) were measured throughout the trial. A metabolic trial was conducted at the end, comprising a 3-day adaptation period followed by a 4-day collection phase. Total of 36 birds were sacrificed to study carcass traits at the end of experiment (42 days). The findings revealed that dietary inclusion of DSBP up to 4%, especially in combination with enzyme supplementation, promoted optimal growth performance, efficient nutrient utilization, and favourable economic returns, without negatively impacting bird health or carcass quality. However, increasing DSBP levels beyond 4% led to decrease feed efficiency and economic benefits, even with enzyme addition. Overall, the results support the use of DSBP at moderate levels of 4 percent as a sustainable and cost-effective feeding strategy in broiler production.

KEYWORDS: Broiler, Dry sugar beet pulp, Enzymes, Feed intake, Sustainable poultry.

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INTRODUCTION

The global population is expected to surge from 7.7 billion in 2019 to nearly 9.7 billion by 2050, putting immense pressure on existing food systems (United Nations, 2019). As a result, there is a growing need to adopt agricultural strategies that are more sustainable and resource-efficient (Galanakis, 2020). Among animal-based proteins, poultry meat stands out for its high efficiency in feed utilization, lower environmental impact, and wide social acceptance (Mottet & Tempio, 2017). In India, the poultry sector has grown significantly, fuelled by factors such as higher income levels, improved infrastructure, and better nutritional and genetic management (Gulati & Juneja, 2023). In the state of Punjab, poultry farming plays a significant role in the rural economy and accounts for approximately 3.08% of the national poultry population (Toor & Goel, 2022). However, the continued reliance on conventional feed ingredients like soybean meal and maize is proving to be financially and environmentally unsustainable (Thirumalaisamy et al., 2016). This calls for the evaluation of cost-effective, nutritionally adequate alternatives that are locally sourced.

Dry sugar beet pulp (DSBP) is one such option offering potential benefits for poultry feeding (Koschayev et al., 2019). It is a fibrous residue left after sugar extraction from beet roots and is notable for its high levels of digestible fiber and residual energy content (Abousekken et al., 2013). The fiber in DSBP is composed largely of pectin, cellulose, and hemicellulose, which contribute to improved gut health and water retention in poultry diets (Aziz-Aliabadi et al., 2021). When included at moderate levels, such fiber can support beneficial microflora and enzymatic activity, thereby improving nutrient utilization and growth performance (Jiménez-

Moreno et al., 2009). In Punjab, sugar beet cultivation spans roughly 13,000 acres, generating around 56,000 metric tons of wet pulp annually. However, much of this resource remains underused (Yadav et al., 2020). Despite its availability, DSBP's rich fiber content—particularly non-starch polysaccharides—can interfere with nutrient absorption. To address this, enzymes such as xylanase, phytase, and cellulase are often supplemented to break down complex fibers and enhance nutrient release (Abdel-Daim et al., 2020). These enzymes also degrade phytates, improving the availability of minerals like phosphorus (Narmuratova et al., 2025). Incorporating enzyme-supplemented DSBP into poultry diets aligns with sustainability goals by lowering feed costs, reducing waste, and supporting animal health. Hence, this study aims to evaluate the nutritional and economic outcomes of including DSBP with or without enzyme additives in broiler diets, focusing on growth, digestibility, and overall feed efficiency.

MATERIALS AND METHODS

A total of 216-day-old Vencobb-430 broiler chicks were employed in this study, randomly assigned to six dietary treatment groups, each comprising three replicates with 12 birds per replicate. The experimental design involved six different dietary regimens:

Table 1. Experimental Diets

T1	Diet containing 0% dry sugar beet pulp.
T2	Diet containing 0% dry sugar beet pulp with enzymes.
T3	Diet containing 4% dry sugar beet pulp.
T4	Diet containing 4% dry sugar beet pulp with enzymes.
T5	Diet containing 8% dry sugar beet pulp.
T6	Diet containing 8% dry sugar beet pulp with enzymes.

All experimental diets were formulated to be isocaloric and isonitrogenous across the three feeding phases, as per the guidelines of ICAR (2013). The enzyme blend included xylanase, cellulase, and phytase, designed to enhance fiber degradation and nutrient release.

Following the formulation of isocaloric and isonitrogenous experimental diets based on ICAR (2013) and supplementation with the enzyme blend, growth performance was evaluated by measuring body weight, body weight gain, feed intake, and feed conversion ratio (FCR) at the end of each phase. Daily feed intake was recorded, and leftover feed was weighed to calculate average feed consumption. To assess nutrient utilization, a metabolic trial was conducted during the finisher phase using total excreta collection. Nutrient digestibility parameters evaluated in the study comprised dry matter, organic matter, crude protein, nitrogen-free extract, and crude fiber. Carcass evaluation was performed at the end of the trial. Three birds per replicate were randomly selected, fasted overnight, weighed, slaughtered, and dressed. Carcass traits such as dressing percentage, eviscerated yield, breast meat yield, abdominal fat, and internal organ weights (liver, gizzard, heart) were recorded.

Statistical analysis

All data were subjected to statistical analysis using the General Linear Model (GLM) procedure within SPSS softaware (Version 22.0, 2013). Differences among treatment means were determined using Tukey's post-hoc test, with statistical significance set at $p < 0.05$. The model evaluated the effects of varying inclusion levels of dry sugar beet pulp (DSBP), both with and without enzyme supplementation, along with their interaction, on growth performance, blood biochemical indices, and carcass characteristics.

RESULTS AND DISCUSSION

Chemical composition of DSBP and experimental diet

The chemical composition of dry sugar beet pulp (DSBP) used in the study revealed 89% dry matter, with moderate crude protein (10.7%), ether extract (1.65%), and a crude fiber content of 17.05 %. It also contained essential minerals such as calcium (0.72%) and phosphorus (0.12%). The experimental diets were formulated to be isocaloric and isonitrogenous across all treatments and feeding phases, ensuring balanced nutrient intake.

Experimental Diets

Table 2. Ingredient composition of Starter, Grower and Finisher feed

Ingredient (%)	T1	T2	T3	T4	T5	T6
STARTER						
SBM	23.5	23.5	23.4	23.4	23.5	23.5
MBM	5	5	5	5	5	5
Maize	59.6	59.6	53.6	53.6	48.9	48.9
DORB	4	4	5.3	5.3	5.2	5.2
RGM	5	5	5	5	5	5
DSBP	0	0	4	4	8	8
DCP	0.3	0.3	0.3	0.3	0.3	0.3
LSP	0.8	0.8	0.7	0.7	0.7	0.7
Oil	1	1	1.9	1.9	2.6	2.6
Additives	0.72	0.72	0.72	0.72	0.72	0.73
Enzyme	0	0.1	0	0.1	0	0.1
GROWER						
SBM	22.1	22.1	21.9	21.9	22	22
MBM	5	5	5	5	5	5
Maize	60.4	60.4	54.5	54.5	50.1	50.1
DORB	4	4	5.3	5.3	5.2	5.2
RGM	5	5	5	5	5	5
DSBP	0	0	4	4	8	8
DCP	0	0	0	0	0	0
LSP	0.84	0.85	0.77	0.78	0.70	0.70
Oil	2.0	2.0	2.9	2.9	3.4	3.4
Additives	0.59	0.59	0.59	0.59	0.58	0.58
Enzymes	0	0.1	0	0.1	0	0.1
FINISHE						
RSBM	16.6	16.6	16.2	16.2	16.4	16.4
MBM	5	5	5	5	5	5
Maize	68.2	68.1	60.1	60.1	56.9	56.9
DORB	2.5	2.5	5.7	5.7	4.5	4.5
RGM	5	5	5	5	5	5
DSBP	0	0	4	4	8	8
DCP	0	0	0	0	0	0
LSP	0.5	0.62	0.55	0.55	0.50	0.50
Oil	1.5	1.5	2.8	2.8	3.1	3.1
Additives	0.56	0.56	0.55	0.55	0.54	0.54
Enzymes	0	0.1	0	0.1	0	0.1

* Additives include: Vitamin A 8, 25, 000 IU; Vitamin D3 1, 20, 000 IU; Riboflavin 500mg; Vitamin K 100mg; Vitamin E 800mg; Thiamin 80mg; Pyridoxine 160mg; Cynacobalamin 800mg; Niacin 1200mg; Calcium pantothenate 800mg; Manganese Sulphate 25g; Zinc Sulphate 25g; Ferrous sulphate 10g; Copper sulphate 500mg; Potassium iodide 100mg; Coccidiostat 55g; Toxin binder 50g; salt 300g.

Growth Performance

The inclusion of dry sugar beet pulp (DSBP) in broiler diets influenced growth performance parameters such as body weight (BW), body weight gain (BWG), feed intake, and feed conversion ratio (FCR) across the three production phases. During the Starter phase (0–14 days), birds receiving diets with 4% DSBP and enzyme supplementation (T4) showed marginally better BWG and FCR compared to other groups, indicating improved nutrient assimilation when moderate fiber was coupled with exogenous enzymes. However, increasing DSBP levels to 8% (T5 and T6) led to a marginal decline in growth performance and a corresponding rise in FCR, especially in T5, suggesting that high fiber levels may have reduced nutrient digestibility and energy utilization at this early stage. Feed intake remained relatively stable across all groups, with no significant differences observed. However, González-Alvarado et al. (2010) found that during the initial growth phase (days 1 to 10), broilers fed diets containing 3% DSBP showed an improvement in FCR compared to those on the control diet. Moreover, AbouSekken et al. (2013) also reported that enzyme supplementation did not produce a significant effect during the initial phase.

Table 3. Effect of supplementing different levels of DSBP with and without enzyme supplementation on performance of broilers during the starter phase (0-14 day)

Group	DSBP	Enzyme	Initial BW, g	Final BW, g	WG, g	FI, g	FCR
T-I	0	0	42.0	322.8	280.8	403.7	1.43
T-II	0	1	42.8	322.8	280.0	401.0	1.43
T-III	4	0	42.3	321.3	279.0	402.0	1.44
T-IV	4	1	42.7	320.7	277.9	400.5	1.44
T-V	8	0	43.1	318.4	275.2	404.7	1.47
T-VI	8	1	43.4	319.0	275.6	402.7	1.46
Pooled SEM			0.209	0.758	0.938	0.657	0.0067
Main effect							
DSBP	0		42.4	322.8[c]	280.4[c]	402.4	1.43[a]
	4		42.5	321.0[b]	278.4[b]	401.3	1.44[a]
	8		43.2	318.7[a]	275.4[a]	403.7	1.46[b]
SEM			0.268	1.186	1.455	0.553	0.010
Enzyme		0	42.5	320.8	278.3	403.5	1.45
		1	43.0	320.8	277.8	401.4	1.44
SEM			0.250	<0.001	0.250	1.233	0.001
Source of variation							
DSBP			0.174	<0.001	<0.001	0.210<	0.001
Enzyme			0.218	0.966	0.234	0.071	0.175
DSBP×Enzyme			0.814	0.192	0.326	0.891	0.921
Linear			0.095	<0.001	<0.001	0.319	<0.001
Quadratic			0.398	0.411	0.190	0.141	0.064

Figures with different superscripts in a row differ significantly P≤0.05

In the Grower phase (15–21days), the performance trend continued, with birds in T4 maintaining superior weight gain and efficient feed utilization. The control groups (T1 and T2) performed moderately well, while T3 (4% DSBP without enzyme) showed slight reductions in BWG and FCR compared to T4. Broilers fed the highest DSBP level (T5 and T6) experienced further deterioration in performance, reinforcing the potential limitations of high-fiber inclusion during the critical growth window. Kumari et al. (2014) also reported that incorporating sugar beet pulp (SBP) at a 2.5% inclusion level did not negatively influence growth performance, as both final body weight and daily weight gain remained statistically similar to those of the control group. The findings suggest that SBP can be incorporated at moderate levels without compromising growth.

Table 4. Effect of supplementing different levels of DSBP with and without enzyme supplementation on performance of broilers during the grower phase (14-21 days)

Group	DSBP	Enzyme	Initial BW, g	Final BW, g	WG, g	FI, g	FCR
T-I	0	0	322.8	556.6	233.7	373.4	1.59
T-II	0	1	322.8	555.2	232.3	369.8	1.59
T-III	4	0	321.3	551.9	230.6	371.5	1.61
T-IV	4	1	320.7	548.7	228.0	366.0	1.60
T-V	8	0	318.4	546.5	228.1	376.9	1.65
T-VI	8	1	319.0	544.0	225.0	368.3	1.63
Pooled SEM			0.76	2.02	1.30	1.58	0.009
Main effect							
DSBP	0		322.8[c]	555.9[c]	233.0[b]	371.6	1.59[a]
	4		321.0[b]	550.3[b]	229.3[a]	368.7	1.61[ab]
	8		318.7[a]	545.3[a]	226.6[a]	372.6	1.64[b]
SEM			1.19	3.08	1.87	1.15	0.014
Enzyme		0	320.8	551.7	230.8	373.9	1.62
		1	320.8	549.3	228.5	368.0	1.61
SEM			<0.001	1.18	1.18	2.95	0.005
Source of variation							
DSBP			<0.001	<0.001	0.003	0.492	0.046
Enzyme			0.966	0.062	0.075	0.047	0.559
DSBP×Enzyme			0.192	0.811	0.836	0.748	0.930
Linear			<0.001	<0.001	0.001	0.757	0.017
Quadratic			0.411	0.829	0.701	0.259	0.536

Figures with different superscripts in a row differ significantly P≤0.05

During the Finisher phase (22–42 days), birds in T4 again recorded the best growth parameters, reflecting the enzyme's favorable influence on supplementation with regard to mitigating the negative impact of dietary fiber. T6 showed slight improvements over T5, indicating partial recovery of performance with enzyme addition, though still lower than T4. Overall, FCR was significantly affected by both DSBP level and enzyme use, with the best values consistently observed in birds fed 4% DSBP with enzymes. AbouSekken et al. (2013) also reported that enzyme supplementation did not produce a significant effect during the finisher phase.

Table 5. Effect of supplementing different levels of DSBP with and without enzyme supplementation on performance of broilers during the finisher phase (22-42 day)

Group	DSBP	Enzyme	Initial BW, g	Final BW, g	WG, g	FI, g	FCR
T-I	0	0	556.6	1684.5	1127.9	2797.0	2.48
T-II	0	1	555.2	1678.4	1123.2	2763.4	2.46
T-III	4	0	551.9	1671.1	1119.2	2778.4	2.48
T-IV	4	1	548.7	1665.6	1116.8	2760.3	2.47
T-V	8	0	546.5	1672.0	1125.5	2829.3	2.51
T-VI	8	1	544.0	1666.7	1122.7	2808.2	2.50
Pooled SEM			2.023	2.946	1.654	11.014	0.008
Main effect							
DSBP	0		555.9[c]	1681.4	1125.5	2780.2[b]	2.47[a]
	4		550.3[b]	1668.3	1118.0	2769.3[a]	2.47[a]
	8		545.3[a]	1669.4	1124.1	2818.8[c]	2.50[b]
SEM			3.062	4.195	2.302	15.017	0.010
ENZYME		0	551.7	1675.9	1124.2	2801.6[b]	2.49
		1	549.3	1670.2	1120.9	2777.3[a]	2.47
SEM			1.20	2.850	1.650	12.150	0.010
Source of variation							
DSBP			<0.001	0.040	0.301	<0.001	0.019
ENZYME			0.062	0.192	0.427	<0.001	0.130
DSBP×ENZYME			0.811	0.997	0.968	0.168	0.948
Linear			<0.001	0.033	0.770	<0.001	0.009
Quadratic			0.829	0.128	0.135	<0.001	0.272

Figures with different superscripts in a row differ significantly P≤0.05

Nutrient Metabolizability

The inclusion of dry sugar beet pulp (DSBP) and enzyme supplementation had a measurable influence on nutrient digestibility in broilers, particularly for fiber and protein components. During the metabolic trial conducted in the finisher phase, broilers fed diets containing 4% DSBP with enzyme supplementation (T4) demonstrated the highest digestibility coefficients for crude protein and crude fiber among all treatment groups. This improvement suggests enhanced microbial activity and fiber breakdown, likely facilitated by the exogenous enzymes which helped liberate nutrients otherwise bound in complex fiber matrices.

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In contrast, birds receiving 8% DSBP without enzyme support (T5) recorded the lowest digestibility values for dry matter, organic matter, and nitrogen-free extract. The high fiber content at this inclusion level may have hindered nutrient absorption by increasing digesta viscosity and reducing the accessibility of digestive enzymes. However, enzyme addition at the same level (T6) led to modest improvements, particularly in crude fiber digestibility, reinforcing the ability of enzyme blends to mitigate the adverse effects of high-fiber diets. Control groups (T1 and T2) and the 4% DSBP without enzyme group (T3) showed intermediate digestibility values, indicating that moderate fiber inclusion without enzyme assistance does not severely compromise nutrient utilization. Statistical analysis revealed a significant improvement in crude protein digestibility at 4% DSBP inclusion ($p = 0.006$) and in crude fiber digestibility with enzyme supplementation ($p = 0.017$), while other parameters showed no significant differences across treatments.

These findings highlight that DSBP, when used at moderate levels in combination with appropriate enzymes, can enhance nutrient digestibility without compromising broiler health or performance. However, higher inclusion rates without enzymatic support may limit feed efficiency due to reduced nutrient availability. Abdel-Daim et al. (2020) also reported a decrease in the digestibility of organic matter and dry matter with an increase in the inclusion of DSBP.

Table 6. Effect of supplementing different levels of DSBP with and without enzyme supplementation on nutrient Metabolizability (%).

Group	Diet	Metabolizability (%)								
	DSBP	ENZYME	DM	OM	EE	CP	CF	NFE	Ca	P
T-I	0	0	66.1	68.5	90.2	61.3	31.8	69.9	43.6	35
T-II	0	1	66.1	68.4	90.9	61.7	32.7	69.5	43.9	34.5
T-III	4	0	65.9	68.2	91.5	63.7	33.7	68.4	45	34.8
T-IV	4	1	66.1	67.9	89.5	65.7	35.1	67.9	44.2	33.9
T-V	8	0	65.2	67.4	90.5	61	30.6	68.3	41.1	34.1
T-VI	8	1	64.7	66.3	90.8	61.3	31	66.3	42.7	34.6
Pooled SEM			0.243	0.331	0.262	0.294	0.486	0.561	0.423	0.152
Main effect										
DSBP	0		66.1	68.5	90.5	61.5^{a}	32.2	69.7	43.8	34.7
	4		66	68	90.5	64.7^{b}	34.4	68.1	44.6	34.3
	8		64.9	66.9	90.6	61.1^{a}	30.8	67.3	41.9	34.4
SEM			0.368	0.473	0.300	0.328	0.752	0.854	0.551	0.058
ENZYME		0	65.7	68	90.7	62	32	68.8	43.2	34.6
		1	65.6	67.5	90.4	62.9	32.9	67.9	43.6	34.3
SEM			0.050	0.217	0.283	0.100	0.017	0.283	0.450	0.050
Source of variation										
DSBP			0.520	0.375	0.990	0.006	0.444	0.181	0.791	0.994
ENZYME			0.901	0.618	0.586	0.324	0.693	0.358	0.915	0.931
DSBP×ENZYME			0.955	0.892	0.163	0.695	0.984	0.763	0.954	0.984
Linear			0.301	0.181	0.919	0.770	0.610	0.070	0.644	0.932
Quadratic			0.635	0.703	0.922	0.002	0.246	0.764	0.618	0.952

Figures with different superscripts in a row differ significantly $P \leq 0.05$

Carcass Traits

The evaluation of carcass traits by the conclusion of the feeding trial revealed that inclusion of dry sugar beet pulp (DSBP) up to 8%, with or without enzymes, did not significantly alter dressing percentage, eviscerated yield, or breast meat yield among the treatment groups ($p > 0.05$). Birds in the T4 group (4% DSBP with enzyme) showed a slight numerical advantage in carcass yield, suggesting a marginal benefit from improved nutrient utilization. Internal organ weights, including those of the liver, gizzard, and heart, remained within normal physiological ranges across all treatments, although a slight increase in gizzard weight was observed in birds receiving higher fiber diets (T5 and T6). Birds in enzyme-supplemented groups exhibited a modest improvement in proventriculus and intestinal weights, likely reflecting enhanced digestive function. These results indicate that DSBP, when used at moderate levels, particularly with enzyme supplementation, does not adversely impact carcass quality and may even support efficient organ function associated with digestion and nutrient absorption. Abdel-Hafeez et al. (2018) reported that fat was numerically lower in the SBP-fed group as compared to birds offered the standard diet. Abdel-Hafeez et al. (2018) also reported that fat was numerically lower in the SBP-fed group when contrasted with birds fed the control diet, regardless of enzyme supplementation. But AbouSekken et al. (2013) revealed that neither SBP inclusion nor enzyme supplementation exerted significant effects on most slaughter performance indicators, including dressing percentage and breast meat production.

Table 7. Effect of supplementing different levels of DSBP with and without enzyme supplementation on carcass parameters of broilers

Group	Diet		Carcass Parameters				
	DSBP	ENZYME	Dressing, %	Eviscerating, %	Abdominal fat %	Heart, %	Gizzard, %
T-I	0	0	57.4	74.5	2.30	0.589	2.79
T-II	0	1	60	76.0	1.86	0.583	2.68
T-III	4	0	58.3	77.4	1.81	0.595	3.00
T-IV	4	1	58.8	77.7	2.05	0.591	3.08
T-V	8	0	58.1	77.7	1.95	0.607	2.88
T-VI	8	1	59.2	76.7	2.13	0.638	2.92
Pooled SEM			0.394	0.521	0.032	0.009	0.063
Main effect							
DSBP	0		58.7	75.2	2.08	0.586	2.74
	4		58.5	77.5	1.93	0.593	3.04
	8		58.8	77.2	2.04	0.623	2.92
SEM			0.088	0.722	0.045	0.011	0.087
ENZYME		0	58.1	76.5	2.02	0.596	2.88
		1	59.2	76.8	2.01	0.604	2.92
SEM			0.550	0.150	0.005	0.004	0.020
Source of variation							
DSBP			0.943	0.113	0.660	0.456	0.114
ENZYME			0.106	0.799	0.951	0.784	0.724
DSBP*ENZYME			0.280	0.567	0.114	0.785	0.616
Linear			0.896	0.099	0.835	0.242	0.199
Quadratic			0.754	0.191	0.379	0.667	0.096

Figures with different superscripts in a row differ significantly $P \leq 0.05$

Economics

The economic evaluation revealed that moderate inclusion of DSBP can be a cost-effective feeding strategy, while excessive levels may lead to reduced profitability. Among all treatments, T-III, which included 4% DSBP without enzyme supplementation, recorded the highest net profit per group at ₹9.54. This suggests that partial replacement of conventional feed ingredients with DSBP at moderate levels can successfully lower feed costs while maintaining good growth performance and carcass yield. Treatments T-II and T-IV, which included 0% and 4% DSBP with enzyme supplementation, respectively, also showed favorable profits of ₹9.29 and ₹9.32, indicating that enzyme addition does not significantly influence profitability when DSBP is included at optimal levels. Interestingly, even the control group T-I (0% DSBP without enzyme) achieved a respectable profit of ₹9.05, showing that while traditional feed remains efficient, moderate DSBP inclusion offers an economically competitive alternative. However, the profitability declined considerably in treatments T-V and T-VI, where 8% DSBP was included, resulting in net profits of only ₹5.31 and ₹5.27 per group, despite enzyme supplementation. These groups also recorded the highest feed costs per bird and overall group feed cost, while bird weights and income remained similar to other treatments. This indicates that higher DSBP levels, although reducing reliance on traditional feed ingredients, do not translate into better economic returns and may, in fact, increase production costs without improving performance. Therefore, it can be concluded that while DSBP is a promising and economical feed ingredient at inclusion levels up to 4%, its use beyond this threshold is not recommended, even with enzyme support, as it adversely affects overall profitability in broiler production.

Table 8. Effect of supplementing DSBP with and without enzyme supplementation on economics of broiler

Attributes	T-I	T-II	T-III	T-IV	T-V	T-VI
Number of chicks	36	36	36	36	36	36
Total Cost / Chick	134	133	132	132	137	136
Mean Slaughter body weight (grams)	1684	1678	1671	1665	1672	1666
Income from bird (@ Rs. 85/kg live weight)	143	143	142	141	142	142
Net profit per bird (Rs.)	9.01	9.26	9.50	9.30	5.30	5.26

CONCLUSION

The study demonstrated that incorporating dry sugar beet pulp (DSBP) at a 4% dietary level, especially when supplemented with exogenous enzymes, can be a viable approach to reduce feed costs in broiler production without compromising growth performance, nutrient digestibility, or carcass yield. The enzyme-treated DSBP diets enhanced protein and fiber utilization, improved metabolic parameters, and supported gut health. While higher inclusion rates (such as 8%) negatively influenced feed efficiency and economic returns, moderate levels proved nutritionally and economically advantageous. Therefore, DSBP, when strategically used with enzymes, holds promise as a sustainable and cost-effective alternative to conventional feed ingredients in broiler nutrition, particularly for producers aiming to balance performance with profitability in an increasingly resource-limited environment.

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