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Research Article

Effect of feeding fermented rapeseed meal on the nutrient retention and carcass characteristics of commercial broiler chickens

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Abstract

This study investigates the effects of feeding commercial broiler chickens fermented rapeseed meal (FRSM) at varying amounts on nutrient retention and carcass characteristics. Three hundred and fifty broiler chicks were randomly assigned to ten replicates of five chicks each. The control diet (T1) was corn-soybean meal based standard diet, while in the 6 experimental diets, 5% (T2), 10% (T3) and 15% (T4) of raw rapeseed meal (RSM) was incorporated and in T5 (5%), T6 (10%) and T7 (15%) fermented RSM. After 42 days, a three-day metabolic trial was conducted on one randomly selected bird from each replicate, and at the end of the sixth week, ten birds per dietary group (one from each replicate) were randomly chosen to assess the carcass traits. It was found that birds fed diets containing 5% RSM and 5% and 10% FRSM showed significantly higher dry matter (DM) utilization compared to the control group. Additionally, crude protein (CP) utilization was significantly higher (P<0.05) in diets containing 5% and 10% raw RSM and 5%, 10%, and 15% fermented RSM. A significant difference (P<0.05) in breast weight was observed across the dietary groups; the birds fed a 10% FRSM diet had the highest breast weight, while those on the 15% RSM diet had the lowest. In conclusion, the inclusion of fermented rapeseed meal up to 10% in broilers' diet showed improvement in nutrient retention and carcass characteristics.

Keywords: Broilers**,** Carcass characteristics, Fermented rapeseed meal, Nutrient retention

Highlights

- Fermented rapeseed meal improved feed efficiency.
- Fermentation does not compromise protein utilization
- Fermented rapeseed meal has the potential to enhance meat yield.

INTRODUCTION

As worries about the environmental effects, price volatility, and supply instability of soybean meal- the main protein source in commercial broiler diets increase, the global poultry industry is constantly looking for sustainable and affordable substitutes for conventional feed ingredients (Gao et al., 2020). The excellent amino acid profile and local availability of rapeseed meal, a byproduct of oil extraction, have made it a suitable replacement. However, the existence of antinutritional substances that can affect nutrient absorption and bird performance has historically limited its usage in broiler nutrition (Konkol et al., 2024). Rapeseed meal's nutritional value has increased dramatically as a result of recent developments in feed processing, particularly fermentation. In addition to lowering antinutritional substances, the fermentation process increases nutrient availability, adds probiotic qualities, and can help poultry's intestinal health (Sugiharto, 2022). Research has shown that adding fermented rapeseed meal to broiler diets can partially substitute soybean meal without affecting the health, feed efficiency, or growth performance of the birds (Khattak et al., 2024; Konkol et al., 2024). Further advantages of fermented rapeseed meal include better intestinal morphology, less colonization of harmful bacteria, and a smaller environmental impact because of fewer greenhouse gas emissions from the production of broilers (Sugiharto, 2022; Khattak et al., 2024). The use of fermented rapeseed meal in commercial broiler diets is a tempting solution since the poultry industry is under increasing pressure to implement more robust and sustainable feeding practices. This article focuses on the effect of the inclusion of fermented rapeseed meal on nutrient retention and carcass characteristics of commercial broilers.

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MATERIALS AND METHODS

Experimental design: The trial was conducted on 350-day-old broiler (VenCobb-400) obtained and reared for a period of six weeks. The day-old chicks were wing banded, weighed individually and distributed randomly to 7 dietary treatments with 10 replicates and 5 chicks in each replicate. All the birds were raised under uniform management and fed with respective iso-caloric and iso-nitrogenous diets in ad libitum from day old to 6 weeks of age. Birds were immunized for Newcastle disease on 7th and 28th day of age with Lasota vaccine and for infectious bursal disease on the 14th and 21st day of age with Georgia strain vaccine. Clean and fresh drinking water was provided ad libitum daily.

Experimental diets: A standard corn-soybean meal-based diet was prepared for pre-starter (0-14 days), starter (15-28 days) and finisher (29-42 days) for broiler chicks to meet the nutritional requirements. The control diet (T1) was fed corn-soybean meal based standard diet, while in 6 experimental diets, 5 (T2), 10 (T3) and 15% (T4) of raw rapeseed meal (RSM) was incorporated and in T5, T6 and T7 fermented RSM (fermented with *Enterococcus faecium* and *Lactobacillus plantarum*) was incorporated at 5, 10 and 15%, respectively. All the diets were iso-nitrogenous and iso-caloric.

Nutrient retention: The availability of nutrients (DM, CP, CF, EE and NFE) for each replicate was calculated. One bird was chosen at random from each replication after the 42nd day, and they were transferred to metabolic cages that had already been cleaned and sanitized. Before conducting a three-day metabolic trial the birds were fasted prior to the collection period for 17 hours to ensure the emptying of the gastrointestinal tract. Every day, using the total collection method, the weight of each bird's droppings and feed consumption were recorded while the birds in each group were fed their respective diets. After weighing and oven-drying the collected droppings to a consistent weight at 70°C, the dried fecal sample was ground and brought to a lab to determine its proximate composition in accordance with AOAC (Cao, 2023). The following formula was used to calculate apparent nutrient digestibility:

$$\text{Nutrient retention (\%)} = \frac{\text{Nutrient intake-Nutrient excreted}}{\text{Nutrient intake}} \times 100$$

Carcass characteristics: For carcass traits, 10 birds per dietary treatment (one from each replicate) were selected randomly at the end of 6 weeks. The birds were kept off feed, and water was withdrawn for 3 hours prior to their sacrifice. Immediately after recording their live weights, the birds were sacrificed by severing the jugular vein and allowed to bleed completely following 'Halal' method. Their heads were removed at the atlanto-occipital joint and shank at the hock joint. The shanks were cut off at the bock joint, and carcass was subjected to the scalding process at 60°C for 30 seconds. The feathers were removed completely by hand-picking and leaving the skin intact. Thereafter, the abdominal cavity was opened to expose the visceral organs, and the carcass characteristics were evaluated. The data pertaining to carcass characteristics, viz., weights of total carcass, dressing percentage, weight of the breast, gizzard, heart, liver, abdominal fat, during the course of the experiment were recorded. The values obtained were expressed as a percentage of live weight.

Statistical analysis was done using the application IBM SPSS Statistics Version 20.

RESULTS

Effect of fermented rapeseed meal on nutrient retention

The data pertaining to apparent nutrient retention in broilers fed diets with raw and fermented RSM included at various levels are detailed in Table 1 and Fig. 1.

Table 1. Effect of dietary inclusion of raw and fermented rapeseed meal on nutrient retention (%) in broilers

Diet	Dry matter	Crude protein	Crude fibre	Ether extract	Nitrogen Free Extract
Control	60.83^{ab}	62.69^{abc}	58.55	83.52	70.79^{ab}
5% RSM	67.29^{a}	76.56^{a}	64.91	86.93	75.29^{a}
10% RSM	61.94^{ab}	61.54^{abc}	60.19	85.35	70.56^{ab}
15% RSM	53.42^{b}	49.21^{c}	50.67	82.71	63.41^{b}
5% FRSM	63.49^{a}	67.29^{ab}	61.58	85.76	72.37^{a}
10% FRSM	65.26^{a}	68.49^{ab}	63.51	86.20	73.64^{a}
15% FRSM	58.09^{ab}	59.94^{bc}	55.79	85.93	68.84^{ab}
N	10	10	10	10	10
SEM	1.244	1.998	1.370	0.468	0.998
P-Value	0.05	0.01	0.09	0.17	0.04

^{abc}Means with different superscripts in a column differ significantly (P<0.05, P<0.01)

P-value: Probability value. N: number of replicates; SEM: Standard Error Mean; RSM: Rapeseed meal included in diets at 5, 10 and 15%; FRSM: Fermented rapeseed meal included in diets at 5, 10 and 15%

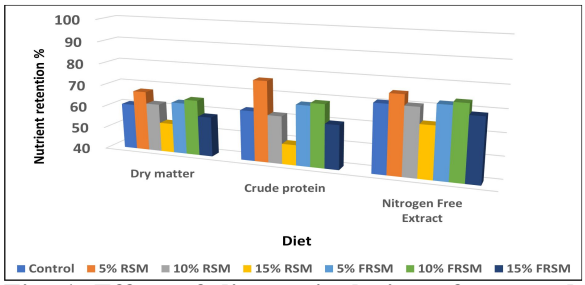


Fig. 1. Effect of dietary inclusion of raw and fermented rapeseed meal on nutrient retention (%) in broilers

Dry matter (DM): The utilization of DM (%) was higher (P<0.05) in broilers fed diets supplemented with 5% RSM (67.29), 10% FRSM (65.26) and 5% FRSM (63.49) and was comparable to those fed the control diet (60.83). The lowest (P<0.05) DM retention was observed in birds fed 15% RSM (53.42), while the retention (%) in birds fed 10% RSM (61.94) and 15% FRSM (58.09) was intermediate and was comparable to control (60.83) fed birds.

Crude protein (CP): In the present study, significant (P<0.05) differences in CP utilization were observed with the incorporation of raw or fermented RSM at 5, 10 and 15% in diets. It was observed that RSM or FRSM incorporated at 5, 10 or 15% in diets had CP retention comparable to control (62.69%). Among RSM diet-fed birds, the highest (P<0.05) CP retention% was observed when RSM was included at 5% RSM (76.56) and the lowest was observed with inclusion of 15% RSM (49.21). Inclusion of RSM at 10% (61.54) and FRSM at 5% (67.29), 10% (68.49), and 15% (59.94) in diets had comparable CP retention and was intermediate of above 2 groups.

Crude fibre (CF): The crude fibre retention (%) in birds fed control (58.55), 5% RSM (64.91), 10% RSM (60.19), 15% RSM (50.67), 5% FRSM (61.58), 10% FRSM (63.51) and 15% FRSM (55.79) diets were comparable and did not differ significantly (P>0.05).

Ether extract (EE): The ether extract retention (%) in birds of control (83.52), 5% RSM (86.93), 10% RSM (85.35), 15% RSM (82.71), 5% FRSM (85.76), 10% FRSM (86.20) and 15% FRSM (85.93) groups were comparable.

Nitrogen free extract (NFE): The NFE retention (%) in birds fed diets containing 5% RSM (75.29), 5% FRSM (72.37), 10% FRSM (73.64) was higher (P<0.05) than those fed 15% RSM (63.41). The NFE retention (%) in birds on 10% RSM (70.56) and 15% FRSM (68.84) diets were comparable to those of the control (70.79).

Effect of fermented rapeseed meal on carcass characteristics

The data pertaining to carcass traits viz., dressing percentage, giblet (gizzard, heart, liver) weight, breast weight and abdominal fat of broiler chicks fed with different levels of raw and fermented rapeseed meal are presented in Table 2 and 3.

Breast weight (g) varied significantly (P<0.05) among the dietary groups, the breast of birds fed 5% RSM (595.20), 5% FRSM (585.10) and, 10% FRSM (599.50) diet was comparable to control (633.3), while lowest (P<0.05) breast weight was observed in birds fed 15% RSM (518.50) diet. The breast weight of birds fed 10% RSM (581.30 g) and 15% FRSM (576.40 g) diets was intermediate of above groups. But when the breast weight was expressed on per cent live weight no significant differences were observed among the dietary groups, which ranged from 24.25 to 26.64 (Table 3). Giblet weight as % of live weight varied significantly (P<0.05) among the dietary groups, the giblet % live weight of 15% RSM (58.62), 5% RSM (56.79), 5% FRSM (56.26), 15% FRSM (55.86), 10% RSM (55.86) are higher, while the lowest (P<0.05) was observed in 10% FRSM (54.21) and control (50.19).

No difference was observed among various dietary groups with regard to dressing percentage, and the values varied from 79.07 to 80.29 % (Table 2). Similarly, no differences were observed with regard to gizzard weight, liver weight, heart weight, giblet weight and abdominal fat weight when expressed in absolute weight or as percentage of live weight , except giblet percentage of live weight and the value varied from 37.90 g to 40.10 g, 15.05 to 17.86 %, 46.13 g to 47.53 g, 18.64 to 21.67%, 14.42 g to 14.81 g, 5.93 to 6.78%, 98.45 g to 102.32 g, 31.90 to 34.05 g and 13.42 to 15.03%, respectively (Table 2 and 3).

Table 2. Effect of dietary inclusion of raw and fermented rapeseed meal on carcass characteristics of broiler chicken

Diet	Dressing %	Gizzard weight (g)	Gizzard % live wt	Liver weight (g)	Liver % live wt	Heart weight (g)	Heart % live wt	Giblet weight (g)	Giblet % live wt
Control	79.91	38.50	15.05	46.35	18.64	14.75	5.93	99.60	50.19[b]
5% RSM	79.23	39.10	17.49	46.24	20.83	14.78	6.64	100.12	56.79[a]
10% RSM	79.07	38.80	17.16	46.17	20.41	14.52	6.54	99.49	55.86[a]
15% RSM	79.09	37.90	17.86	46.13	21.67	14.42	6.78	98.45	58.62[a]
5% FRSM	80.21	40.10	17.64	47.41	20.94	14.81	6.54	102.32	56.26[a]

Cont. Table 2.

Table 3., Cont. ...

Diet	Dressing %	Gizzard weight (g)	Gizzard % live wt	Liver weight (g)	Liver % live wt	Heart weight (g)	Heart % live wt	Giblet weight (g)	Giblet % live wt
10% FRSM	80.29	39.20	16.88	47.53	20.38	14.45	6.19	101.18	54.21[b]
15% FRSM	80.13	38.30	17.21	46.94	21.01	14.68	6.54	99.92	55.86[a]
N	10	10	10	10	10	10	10	10	10
SEM	0.401	0.558	0.253	0.700	0.307	0.248	0.122	1.055	0.593
P-Value	0.95	0.97	0.23	0.99	0.22	0.99	0.57	0.98	0.01

[ab]Means with different superscript in a column differ significantly (P<0.01)
P-value: Probability value. N: number of replicates; SEM: SEM: SEM: Standard Error Mean
RSM: Rapeseed meal included in diets at 5, 10 and 15%; FRSM: Fermented rapeseed meal included in diet at 5, 10 and 15%

Table 3. Effect of dietary inclusion of raw and fermented rapeseed meal on abdominal fat and breast weight of broiler chicken

Diet	Abdominal fat weight(g)	Abdominal fat weight (% live weight)	Breast weight (g)	Breast weight (%live weight)
Control	33.25	13.42	633.30[a]	25.41
5% RSM	32.85	14.78	595.20[a]	26.64
10% RSM	33.80	14.85	581.30[ab]	25.94
15% RSM	31.90	14.94	518.50[b]	24.25
5% FRSM	34.02	15.03	585.10[a]	25.76
10% FRSM	34.05	14.64	599.50[a]	25.63
15% FRSM	32.70	14.52	576.40[ab]	25.54
N	10	10	10	10
SEM	0.829	0.348	8.675	2.352
P-value	0.99	0.91	0.03	0.24

[ab]Means with different superscript in a column differ significantly (P<0.05)
P-value: Probability value; N: number of replicates; SEM: Standard Error Mean;
RSM: Rapeseed meal included in diets at 5, 10 and 15%, FRSM: Fermented rapeseed meal included in diet at 5, 10 and 15%

DISCUSSION

The utilization of dry matter was higher (P<0.05) in broilers fed 5 or 10% RSM or FRSM diets and was comparable with the control (Table 1). Similarly, adding 5% RSM or FRSM to the food increased the birds' retention of CP and NFE (P<0.05), but it was still similar to the control. Although it was statistically comparable to the control, adding 15% RSM to the diet decreased DM, CP, and NFE retention.

Similar to present findings Nie et al. (2015) incorporated 6% fermented cotton seed meal (FCSM) and observed that there is significant (P<0.05) effect on dry matter digestibility in FCSM fed birds when compared to control fed birds and similarly higher (P<0.05) DM retention was observed in birds fed 10% FRSM compared to 10% RSM diet in studies of Chiang et al. (2010). Similar reports were made by Elbaz et al. (2023), 20% fermented canola meal was included in diets. In FRSM-fed birds (5 and 10% inclusion levels) the increase in nutrient retention (DM, CP and NFE) might be due to the process of fermentation.

Regarding CP retention, similar to the present finding, Elbaz et al. (2023) included 20% raw and fermented canola meal and observed that the digestibility of CP in chicks fed with fermented canola meal (FCM) diet increased (P<0.05) compared to those fed with canola meal (CM) and comparable with control-fed birds. Inclusion of 6% fermented cottonseed meal (FCM) and improved CP retention in birds compared to control diet-fed birds (Nie et al., 2015).

In the present study, no effect (P>0.05) on the digestibility of CF and EE was observed. NFE retention was general improved with the inclusion of FRSM in diets compared to corresponding levels of RSM in the diet. Similar to the present findings, Alshelmani et al. (2016) observed a significant (P<0.05) increase in NFE in birds fed 10 and 15% fermented palm kernel cake than PKC-fed birds.

Incorporation of either RSM or FRSM up to 15% in broiler diets did not affect the dressing percentage in the present study (Table 2). Similar to the results of the present findings, Aljubori et al. (2017) observed no significant (P>0.05) effect on carcass yield % in broilers diets containing 30% fermented canola meal compared to the control. Inclusion of raw rapeseed meal and fermented rapeseed meal at 5, 10, 15% in diets had shown that broilers fed diets with raw rapeseed meal showed a significantly (P<0.05) lower dressed and eviscerated yield percentage than fermented rapeseed meal birds, such effect was observed in present study (Wu et al., 2022).

Regarding other carcass traits, no effect (P>0.05) of inclusion of RSM or FRSM up to 15% was observed on gizzard, heart and liver weight and overall giblet weight and abdominal fat (Table 2). Significant difference (P<0.05) was observed with regard to breast weight (Table 3) when compared to the control, but such differences disappeared when expressed on percent live weight. Similar to the present findings, Ashayerizadeh et al. (2018) observed a significant (P<0.05) effect on breast weight by replacing SBM with 50% RSM and FRSM. The higher breast weight might be due to higher availability of protein availability and protein retention (Table 1) that might have helped in deposition of protein into breast meat and improved its weight.

In conclusion, the 15% inclusion of fermented rapeseed meal in the diet did not significantly affect the nutrient retention and carcass characteristics, and there was a significant improvement in DM, CP retention, and breast weight up to the 10% inclusion level. So, fermented rapeseed meal can be included up to 10% in broilers' diets.

Conflict of interest: The authors have no conflict of interest in this study.

Author's contribution: MRV: Involved in investigation, data generation, preparing original draft; DN: Engaged in conceptualization, data curation, supervision and final editing; BV: Involved in statistical analyses, methodology and editing; TS: Engaged in supervision, data curation and final editing; SR: Involved in methodology, data curation and editing.

Data availability statement: The data set generated during research will be available from the corresponding author upon reasonable request.

Ethical approval: This experiment was approved by the IAEC (Institutional Animal Ethics Committee), and the referral number of the approval is 24/26/CVSc,Hyd.IAEC.

Use of artificial intelligence tools: During the preparation of this work, the author(s) used IBM SPSS Statistics Version 20 to perform statistical analysis of data. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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