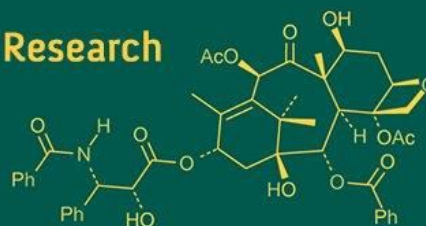


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; 10(2): 457-460
www.biochemjournal.com
Received: 02-12-2025
Accepted: 06-01-2026

RS Kanishkar
B.V.Sc. & A.H., Fourth Year,
Veterinary College and
Research Institute, Namakkal,
Tamil Nadu, India

S Pavnisha
B.V.Sc. & A.H., Fourth Year,
Veterinary College and
Research Institute, Namakkal,
Tamil Nadu, India

R Kavitha
Associate Professor, Livestock
Farm Complex, Veterinary
College and Research Institute,
Orathanadu Tamil Nadu, India

A Natarajan
Professor and Head (Retd.),
Animal Feed Analytical and
Quality Assurance Laboratory,
Veterinary College and
Research Institute, Namakkal,
Tamil Nadu, India

Corresponding Author:
R Kavitha
Associate Professor, Livestock
Farm Complex, Veterinary
College and Research Institute,
Orathanadu Tamil Nadu, India

Effect of replacing solvent extracted soybean meal with extruded expeller soybean meal on growth performance of Japanese quail

RS Kanishkar, S Pavnisha, R Kavitha and A Natarajan

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i2f.7634>

Abstract

This study evaluated the effects of replacing Solvent Extracted Soybean Meal with Extruded Expeller Soybean Meal on the growth performance of Japanese quail. A total of 180 chicks were assigned to three dietary treatments containing T₁ (0%), T₂ (50%) and T₃ (100%) Extruded Expeller Soybean Meal for four weeks. Birds fed 50% Extruded Expeller Soybean Meal (T₂) achieved significantly higher final body weight (191.90 g) than those in T₃ (187.55 g) and the control (180.88 g) ($p < 0.05$). Although, 100% Extruded Expeller Soybean Meal group (T₃) had the best Feed Conversion Ratio (2.26) with slightly lower feed intake (404.50 g), while T₂ was comparable with modest increase in feed intake. Overall, partial replacement at 50% yielded the most favorable balance of body weight, feed intake and growth, whereas full replacement improved Feed Conversion Ratio but did not enhance body weight. These findings indicated that moderate inclusion of Extruded Expeller Soybean Meal optimized nutrient utilization and performance in Japanese quail.

Keywords: Extruded expeller soybean meal, growth performance, Japanese quail, solvent extracted soybean meal

Introduction

Protein nutrition has gained increased global attention in recent years, with poultry meat and eggs recognized as economical and clean protein sources. Among poultry species, quail meat is considered for its delicacy, offering higher protein, lower fat and calorie content, and greater concentrations of essential vitamins (A, C, B-complex) and minerals (Ca, Fe, P, K, Zn, Cu) compared to chicken and duck meat (Quaresma *et al.*, 2022) [1]. Optimal quail production depends heavily on high-quality protein and energy sources with a balanced amino acid profile.

Soybean meal (SBM) remains the most widely used plant protein source in poultry diets because of its high crude protein content, complementary amino acid profile and superior amino acid digestibility (Ravindran *et al.*, 2013) [10]. Conventional solvent-extracted soybean meal (SESBM), produced using solvents such as n-hexane or acetone, contains less than 1-1.5% residual oil following the removal of nearly 95% of the bean oil. Although solvent extraction partially reduces antinutritional factors like trypsin inhibitors, the low residual oil content necessitates the addition of external fat sources to meet metabolizable energy requirements.

Recent advances in processing have led to the development of extruded-expelled soybean meal (EESBM), produced through high-temperature ($\approx 135^\circ\text{C}$), short-time (≈ 30 s), high-pressure extrusion followed by mechanical expelling (Nelson *et al.*, 1987; Newkirk, 2010). Mechanical extraction removes approximately 70% of the oil, yielding a meal with 6.5-10% residual oil. The heat generated during extrusion effectively inactivates antinutritional factors, reduces trypsin inhibitor activity, enhances protein denaturation and increases enzymatic accessibility, thereby improving nitrogen digestibility. The higher residual oil also contributes to increased digestible and metabolizable energy compared to SESBM. Additionally, extrusion improves starch gelatinization, ingredient sterilization and overall feed efficiency in poultry. Hence this research study was conducted to assess the growth performance of feeding EESBM in Japanese quails.

Materials and Methods

A four-week biological trial was conducted using 180-day old Japanese quail chicks, which were individually weighed and divided into three treatment groups (T₁, T₂ and T₃) with three replicates each and 20 chicks per replicate. The experimental birds were reared under cage system and each replicate was housed separately. The replacement levels of SESBM with EESBM in the formulated diet of Japanese quail was given in the Table 1. The composition of the starter and finisher diets were presented in the Table 2 and Table 3, respectively. All the diets were formulated on iso-caloric and iso-nitrogenous basis. The experimental birds were fed with starter diet for first 2 weeks and finisher feed (3 to 4 weeks age). All the birds were allowed *ad libitum* access to drinking water throughout the experiment with nipple drinkers. The experiment lasted for 28 days. The birds were weighed at the end of each week. The feed intake was determined by calculating the difference between the feed offered and the residual feed in each replicate of every treatment group. The feed conversion ratio (FCR) was computed accordingly. Mortality if any also recorded during the entire period of study. The cost of production was also calculated at the end of the study.

All statistical analyses were carried out using SPSS version 25. For data exhibiting a normal distribution, one-way analysis of variance (ANOVA) was applied, and differences among treatment means were determined using Duncan's multiple range test.

Results and Discussion

The effects of replacing Solvent Extracted Soybean Meal (SESBM) with Extruded Expeller Soybean Meal (EESBM) at different levels on the growth performance and economics of Japanese quail is presented in Table 4. A significant improvement in body weight was observed from the second week onwards in quails fed diets containing 50% (T₂) and 100% (T₃) EESBM compared with the control ($p < 0.05$). By the fourth week, the highest body weight was recorded in T₂ (191.9 g), which was 6.1% higher than the control (180.88 g). Although T₃ (187.55 g) also showed improvement, it was less than T₂, indicating that increasing EESBM inclusion from 50% to 100% did not produce a linear enhancement in growth. The body weight gain also followed a similar trend, with T₂ showing the highest overall gain (183.12 g), significantly higher than the control (172.1 g) ($p < 0.05$); whereas, T₃ (178.84 g) showed intermediate weight gain and statistically comparable performance.

The superior performance at 50% EESBM might be attributed to improved nutrient digestibility and reduced anti-nutritional factors resulting from extrusion and expeller processing. Extrusion has been shown to increase protein availability, improve amino acid digestibility and reduce trypsin inhibitors in soybean products (Ravindran, 2013; El-Sayed, 2013) [10, 4]. Previous studies in broilers and quail

have similarly reported improved growth when processed soybean meals were included at moderate levels (Karr-Lilienthal, 2004; Kansal *et al.*, 2023) [6, 5]. However, the slight decline in T₃ performance suggested that excessive replacement might reduce palatability or cause amino acid imbalance, which has been previously documented in birds fed high levels of heat-processed soybean meals (Nourmohammadi and Khosravinia, 2015; Li *et al.*, 2021) [8, 7].

The feed intake was increased from the third week onwards in birds fed 50% EESBM (112.09 g/week). The total feed intake over the experimental period was highest in T₂ (419.07 g), which was 2.71% higher than the control (408 g). Interestingly, the 100% EESBM group (T₃) consumed slightly less feed (404.5 g) than the control, although differences among treatments were not statistically significant. The improved feed intake in T₂ might be linked to the enhanced palatability and textural quality of extruded feed. Extrusion improved the aroma, reduced bitter components and enhanced voluntary intake in poultry (Serrano *et al.*, 2013; Choct, 2017) [12, 3]. The lower feed intake observed in T₃ indicated the reduced palatability at higher processed soybean levels, consistent with previous findings in Japanese quail and broilers (Nourmohammadi and Khosravinia, 2015) [8].

The feed conversion ratio showed significant variation among treatments from the fourth week onward ($p < 0.05$). The overall FCR was lowest in T₃ (2.26), followed by T₂ (2.29), both of which performed better than the control group (2.37). The improved FCR in EESBM-fed birds could be attributed to enhanced starch gelatinization, increased protein digestibility and structural modification of feed particles during extrusion (Abdollahi *et al.*, 2018; Svihus, 2014) [2, 13]. Earlier studies on processed soybean meals in quail and broilers have reported similar improvements in feed efficiency (Sarıçiçek *et al.*, 2005; Ojediran *et al.*, 2020) [11, 9].

The mortality remained low across all treatments. T₁ and T₃ recorded the lowest mortality (1.7%), while T₂ had a slightly higher value (3.3%). As no pathological or clinical abnormalities were detected, the variation is likely due to environmental influence or incidental and unrelated to diet.

The economic assessment of the study presented in Table 4 indicated a significant increase in feed cost per bird in T₂ (₹16.75) and T₃ (₹16.80) compared with the control (₹16.20) ($p < 0.05$). The higher cost might correspond to the relatively higher price of EESBM. Despite this, profit per bird did not vary significantly among the treatments: T₁-₹22.5, T₂-₹20.7 and T₃-₹22.5. This suggested that the improved growth performance especially the better FCR in T₂ and T₃ offsets the increased feed cost. Similar findings were reported in economic analyses of quail and broilers fed processed soybean meals or value-added protein sources (Ojediran *et al.*, 2020; Kansal *et al.*, 2023) [9, 5].

Table 1: Replacement levels of SESBM with EESBM in the formulated diet of Japanese quail

Treatment	Composition of the diet	No of birds/Treatment (3 replicates with 20 birds each)
T ₁ -Control	100% SESBM	60
T ₂ (50 % Replacement of SESBM)	50% SESBM + 50% EESBM	60
T ₃ (100% Replacement of SESBM)	100 % EESBM	60

Table 2: Composition (%) of the starter diet

Ingredients	T ₁ Control (100% SESBM)	T ₂ (50% replacement with EESBM)	T ₃ (100% replacement with EESBM)
Maize	49.0	51.0	52.0
SESBM-(CP-46%)	45.0	22.0	34.0
EESBM-(CP-46%, EE 6.5%)	0	22.5	41.0
Rice bran oil	2.5	9	0
Calcite	1.4	15	15.5
Dicalcium phosphate	1.2	11.5	11
Salt	0.3	3	3
Vitamin and mineral mixture	0.1	0.1	0.1
DL-Methionine	0.27	0.27	0.27
Lysine	0.22	0.22	0.22
Metabolizable energy (Kcal/Kg)	2950	2950	2950
Crude Protein (%)	25	25	25

Table 3: Composition (%) of the finisher diet

Ingredients	T ₁ Control (100% SESBM)	T ₂ (50% replacement with EESBM)	T ₃ (100% replacement with EESBM)
Maize	51.5	53.5	55.1
SESBM-(CP-46%)	42.0	20.0	0
EESBM-(CP-46%, EE 6.5%)	0	21.6	41.3
Rice bran oil	3.1	15.5	2.3
Calcite	14	14	15
Dicalcium phosphate	12	11.5	11
Salt	3.00	3.00	3.00
Vitamin and mineral mixture	0.1	0.1	0.1
DL-Methionine	0.24	0.23	0.24
Lysine	0.12	0.14	0.15
Metabolizable energy (Kcal/Kg)	3000	3000	3000
Crude Protein (%)	24	24	24

Table 4: Effect of diets containing different levels of EESBM on Growth performance and economics of feeding Japanese Quails

Parameters	T ₁ Control (100% SESBM)	T ₂ (50% replacement with EESBM)	T ₃ (100% replacement with EESBM)
Body weight (g)	180.88 ^a	191.9 ^b	187.55 ^{ab}
Weight gain (g)	172.1 ^a	183.12 ^b	178.84 ^{ab}
Feed intake (g)	408	419.07	404.5
FCR	2.37 ^b	2.29 ^a	2.26 ^a
Mortality %	1.7	3.3	1.7
Cost of production of feed/bird (₹)	16.20 ^a	16.75 ^b	16.80 ^b
Cost of profit/bird (₹)	22.5	20.7	22.5

Conclusion

The present study demonstrated that partial replacement of SESBM with EESBM at 50% in the diet could offer optimal improvements in growth performance, weight gain, feed intake and FCR in Japanese quail. Although, 100% replacement improved FCR, it did not contribute to superior body weight compared with 50% replacement. These outcomes aligned with the previous literatures indicating that moderate levels of processed soybean meal enhance nutrient utilization and performance in monogastric species, whereas excessive inclusion may compromise palatability or nutrient balance.

References

- Quaresma MAG, Antunes B, Ferreira G, Parada A, Elias A, Barros M, *et al.* The composition of the lipid, protein and mineral fractions of quail breast meat obtained from wild and farmed specimens of common quail (*Coturnix coturnix*) and farmed Japanese quail (*Coturnix japonica domestica*). *Poult Sci.* 2022;101(1):1-12.
- Abdollahi MR, Ravindran V, Svihus B. Influence of feed processing on the performance, nutrient utilization and gut health of poultry. *Worlds Poult Sci J.* 2018;74(1):1-14.
- Choct M. Feed non-starch polysaccharides and poultry nutrition: A review. *Br J Nutr.* 2017;16(2):49-59.
- El-Sayed AFM. Protein digestibility of extruded feeds. *Aquac Res.* 2013;44(5):1-14.
- Kansal N, Choudhary S, Mehra M. Evaluation of processed soybean meals in broiler nutrition. *Poult Sci.* 2023;102(5):102378.
- Karr-Lilienthal LK. Chemical composition and protein quality of soybean meals. *J Anim Sci.* 2004;82(4):1132-1139.
- Li Y, Zhang S, Kim SW. Effects of enzyme-treated soybean meal on performance and gut health of monogastrics. *J Anim Sci Biotechnol.* 2021;12:1-13.
- Nourmohammadi R, Khosravinia H. Effects of heat-processed proteins on feeding behavior and performance of Japanese quail. *Poult Sci.* 2015;94(10):2358-2365.
- Ojediran TK, Emiola IA, Adebayo AO. Economic evaluation of alternative protein sources in quail production. *Trop Anim Health Prod.* 2020;52:3129-3137.

10. Ravindran V. Feed processing and its impact on nutrient digestibility. *Anim Sci J.* 2013;84(3):103-113.
11. Sarıççek BZ, Kılıç U, Garipoğlu AV. Multi-enzyme and phytase supplementation in canola meal-based diets for quails. *Ankara Univ Vet Fak Derg.* 2005;52:145-151.
12. Serrano MP, Frikha M, Mateos GG. Influence of feed form and heat processing on broiler performance. *Poult Sci.* 2013;92:2970-2984.
13. Svihus B. Function of the digestive system in poultry. *J Appl Poult Res.* 2014;23(2):306-314.