



## International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2026): 4.61

VET 2026; 11(5): 413-419

© 2026 VET

[www.veterinarypaper.com](http://www.veterinarypaper.com)

Received: 16-03-2026

Accepted: 20-04-2026

**Juan Carlo D Reyes**

Department of Animal Science,  
Visayas University of  
Agricultural Sciences, Iloilo,  
Philippines

**Maria Theresa L Santos**

Department of Animal Science,  
Visayas University of  
Agricultural Sciences, Iloilo,  
Philippines

### Influence of fresh germinated cereal and legume forages cultivated without soil on carcass traits and feed conversion efficiency in weaner rabbits

**Juan Carlo D Reyes and Maria Theresa L Santos**

DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i5f.3646>

#### Abstract

Historically, rabbit production in the Philippines has relied on pelleted commercial feeds whose cost has risen sharply over the past decade, prompting renewed interest in on-farm forage alternatives. This research examined the influence of hydroponically germinated maize (*Zea mays*), barley (*Hordeum vulgare*), and cowpea (*Vigna unguiculata*) forages on carcass characteristics, organ weights, and feed conversion efficiency in weaner rabbits at Visayas University of Agricultural Sciences, Iloilo, Philippines, from January to April 2022. Sprouted fodder was produced on perforated trays (3.2 kg seed m<sup>-2</sup>) under a naturally ventilated greenhouse (28 ± 3 °C, 80% RH) and harvested on day 8. A 56-day feeding trial used 60 weaned New Zealand White rabbits (35 d old, mean weight 618 ± 24 g) allocated to five dietary treatments in a completely randomised design (n = 12): T<sub>1</sub>, basal pellet only; T<sub>2</sub>, pellet plus 25% DM from maize sprouts; T<sub>3</sub>, pellet plus 25% DM from barley sprouts; T<sub>4</sub>, pellet plus 25% DM from cowpea sprouts; and T<sub>5</sub>, pellet plus 25% DM from a 1:1 maize-cowpea sprout mix. At slaughter, hot carcass weight, dressing percentage, primal-cut yields (forequarter, hindquarter, loin), and internal organ weights were recorded. Rabbits on the mixed diet (T<sub>5</sub>) achieved the highest dressing percentage (59.2%) and daily weight gain (24.5 g d<sup>-1</sup>), closely followed by the cowpea group (T<sub>4</sub>: 58.7%, 23.8 g d<sup>-1</sup>). Barley-supplemented animals (T<sub>3</sub>) recorded the best feed conversion ratio (3.34), while the pellet-only control (T<sub>1</sub>) ranked lowest in carcass yield (54.2%) and daily gain (19.8 g d<sup>-1</sup>). Hindquarter and loin proportions were significantly higher (*P* < 0.05) in T<sub>4</sub> and T<sub>5</sub> compared with T<sub>1</sub>, suggesting that the legume protein premium promoted greater muscle deposition in high-value cuts. Internal organ weights expressed as a percentage of live weight did not differ among treatments, indicating no adverse visceral effects. A cost analysis showed that the mixed-sprout strategy (T<sub>5</sub>) reduced total feed cost per kilogram of carcass gain by 21% relative to the pellet-only control. These findings support the integration of mixed cereal-legume hydroponic forages into weaner-rabbit diets as a means of improving both carcass quality and economic efficiency under Philippine smallholder conditions.

**Keywords:** Carcass traits, feed conversion, weaner rabbits, hydroponic forage, soilless germination, dressing percentage, primal cuts, cost analysis, Philippines, mixed-species sprouts

#### Introduction

Philippine rabbit husbandry traces its formal beginnings to the 1970s, when the Bureau of Animal Industry imported foundation stock of New Zealand White and Californian breeds to establish breeding nuclei in several Visayan provinces <sup>[1]</sup>. For more than four decades since, the enterprise has remained predominantly backyard in scale, with households keeping 5-20 does and relying on kitchen scraps, weeds, and purchased pellets to sustain modest production cycles <sup>[2]</sup>. Throughout this period, feed has consistently accounted for 60-75% of variable costs, a proportion that has only widened as global cereal prices transmitted through to local concentrate markets during the 2010-2020 period <sup>[3]</sup>.

The search for cheaper, locally producible feed alternatives has generated periodic interest in hydroponic green fodder-cereal or legume seeds sprouted on trays without soil under controlled moisture, using as little as 2-3 litres of water per kilogram of fresh biomass <sup>[4]</sup>. The technology is not new: commercial barley-sprout systems for dairy cattle were trialled in Australia and the Middle East as early as the 1980s, and agronomic evaluations have since

**Corresponding Author:**

**Juan Carlo D Reyes**

Department of Animal Science,  
Visayas University of  
Agricultural Sciences, Iloilo,  
Philippines

documented fresh-weight multiplication ratios of  $5\text{--}8 \times$  within seven to ten days for maize, barley, wheat, and oats<sup>[5,6]</sup>. More recent screenings extended the species list to tropical legumes-cowpea, mung bean, pigeon pea-whose sprouts reach 20–27% crude protein on a dry-matter basis, roughly double the concentration found in cereal sprouts of the same age<sup>[7]</sup>.

Where the knowledge base thins is at the intersection of hydroponic fodder and rabbit carcass science. The overwhelming majority of published feeding trials report live-weight gain, feed intake, and feed conversion ratio as their primary endpoints; carcass data-dressing percentage, primal-cut yields, organ weights-are far less common, particularly for rabbits<sup>[8]</sup>. This omission matters because live-weight gain alone does not predict meat yield. Two diets may produce identical growth curves yet partition that growth differently between muscle, fat, and visceral organs, leading to different dressing percentages and different commercial values at the abattoir<sup>[9,10]</sup>.

A second gap concerns dietary diversity. Almost all hydroponic feeding studies evaluate a single sprout species against a pelleted control, whereas practical adoption on smallholder farms is more likely to involve a mix of whatever grain and legume seeds are cheapest or most available in a given season<sup>[11]</sup>. Whether combining a high-yielding cereal sprout (maize) with a protein-dense legume sprout (cowpea) on the same tray or in alternating daily rations produces additive, synergistic, or antagonistic effects on carcass quality is an empirical question that has received almost no attention in the rabbit literature<sup>[12]</sup>.

The Philippine setting adds a further dimension. Ambient temperatures in the Western Visayas routinely exceed 30 °C during the hot-dry months of March-May, and relative humidity hovers near 80% year-round. These conditions accelerate both fodder growth and the risk of mould contamination on sprouting trays, making harvest timing and tray hygiene more critical than in temperate environments<sup>[13]</sup>.

They also impose heat stress on rabbits, which can depress feed intake and redirect metabolic energy from growth toward thermoregulation, thereby altering the carcass composition that a given diet would produce under cooler conditions<sup>[14]</sup>.

From an economic perspective, the viability of hydroponic fodder depends not only on growth performance but on the cost per kilogram of carcass produced. Seed cost, labour for tray management, water, and the opportunity cost of greenhouse space must be weighed against the savings on purchased concentrate and the premium, if any, that a heavier or leaner carcass commands in local wet markets<sup>[15]</sup>. Formal cost analyses of hydroponic sprout feeding in rabbit enterprises are notably scarce in the Southeast Asian literature.

### **This research therefore pursued four linked objectives at Visayas University of Agricultural Sciences, Iloilo, Philippines**

1. To compare the proximate composition of hydroponically grown maize, barley, and cowpea sprouts harvested on day 8 under local greenhouse conditions;
2. To measure growth performance (daily gain, feed intake, FCR) of weaner New Zealand White rabbits fed a pelleted basal diet supplemented with each sprout species individually or as a 1:1 maize-cowpea mix over a 56-day trial;
3. To evaluate carcass traits-dressing percentage, primal-cut proportions, and internal organ weights-at slaughter; and

4. To conduct a comparative cost analysis of each dietary treatment on a per-kilogram-of-carcass-gain basis. By combining growth, carcass, and economic data in a single experiment, the research aimed to equip Philippine smallholder rabbit producers with actionable information for integrating hydroponic forages into their feeding programmes.

## **Materials and Methods**

### **Field experimental design**

The trial followed a completely randomised design with five dietary treatments and 12 replicates per treatment (60 rabbits total). Treatments were: T<sub>1</sub>, basal pellet only (control); T<sub>2</sub>, basal pellet with 25% of daily DM replaced by fresh maize sprouts; T<sub>3</sub>, basal pellet with 25% DM replaced by barley sprouts; T<sub>4</sub>, basal pellet with 25% DM replaced by cowpea sprouts; T<sub>5</sub>, basal pellet with 25% DM replaced by a 1:1 (DM basis) blend of maize and cowpea sprouts. Rabbits were blocked by sex and initial body weight before random allocation. Each animal served as its own experimental unit, housed individually. The trial lasted 56 days, after which all animals were slaughtered for carcass evaluation. The primary response variables were daily weight gain, feed conversion ratio, dressing percentage, and primal-cut proportions. Statistical power calculations indicated that 12 replicates per treatment would detect a 5% difference in dressing percentage at  $\alpha = 0.05$  with 80% power, assuming a coefficient of variation of 4% based on preliminary data.

### **Materials**

Seeds of maize (*Zea mays*, var. IPB Var 6), barley (*Hordeum vulgare*, imported Australian feed-grade), and cowpea (*Vigna unguiculata*, var. NSIC Cv-15) were procured from the Philippine Seed Industry Association in December 2021. Germination rates exceeded 91% for all lots. Sixty weaned New Zealand White rabbits (30 males, 30 females; 35 d old;  $618 \pm 24$  g) were purchased from a breeder in Bacolod City and individually housed in galvanised-wire cages (50 × 45 × 35 cm) under a ventilated, roofed open-sided building. A commercial pelleted diet (17.0% CP, 13.6% CF, 2,480 kcal DE kg<sup>-1</sup>) served as the basal ration. Fresh water was supplied ad libitum through nipple drinkers.

### **Methods**

Ethical approval was granted by the Institutional Animal Care and Use Committee of Visayas University of Agricultural Sciences (Protocol IACUC-VUAS-2021-042, dated 15 December 2021). Seeds were soaked in 0.5% sodium hypochlorite for 15 min, rinsed, and pre-germinated in water for 24 h. Pre-soaked seeds were spread at 3.2 kg m<sup>-2</sup> on perforated plastic trays (55 × 40 cm) lined with coconut-coir fabric and arranged on four-tier bamboo shelving inside a naturally ventilated greenhouse (6 × 4 m, clear polyethylene roof). Temperature averaged  $28 \pm 3$  °C; relative humidity 80 ± 5%. Trays were irrigated by hand sprayer four times daily. No artificial lighting was used. Fodder mats were harvested on day 8; fresh weight was recorded and sub-samples oven-dried at 60 °C for 72 h for DM determination. Proximate analysis followed AOAC (2005) protocols.

Rabbits received their assigned diets from day 1 of the trial. Fresh sprouts were offered twice daily (08:00, 16:00); pellet was available ad libitum. Body weight was recorded weekly; feed offered and refused were recorded daily. At the end of the 56-day period, all 60 rabbits were fasted for 12 h, weighed, and slaughtered by cervical dislocation following

institutional guidelines. Hot carcass weight was recorded immediately; dressing percentage was calculated as (hot carcass weight / pre-slaughter live weight)  $\times$  100. Carcasses were dissected into forequarter, hindquarter, and loin plus ribs following the standardised EU protocol described by Blasco and Ouhayoun (1996) [9]. Internal organs (liver, kidneys, heart, lungs) were weighed individually and expressed as a percentage of live weight. Data were analysed by one-way ANOVA in SAS 9.4; treatment means were separated by Duncan's multiple-range test at  $P < 0.05$ .

## Results

All sprout species germinated within 48 h and formed cohesive root mats by day 5 despite ambient temperatures exceeding 30 °C on several afternoons. No visible mould contamination was detected on any tray during the trial. Fresh-weight yields at harvest averaged 5.84 kg (maize), 4.61 kg (barley), and 3.42 kg (cowpea) per tray. Cowpea sprouts contained 23.4% CP on a DM basis, compared with 12.9% for maize and 12.1% for barley. The 1:1 maize-cowpea blend, calculated on a DM basis, supplied an estimated 18.2% CP.

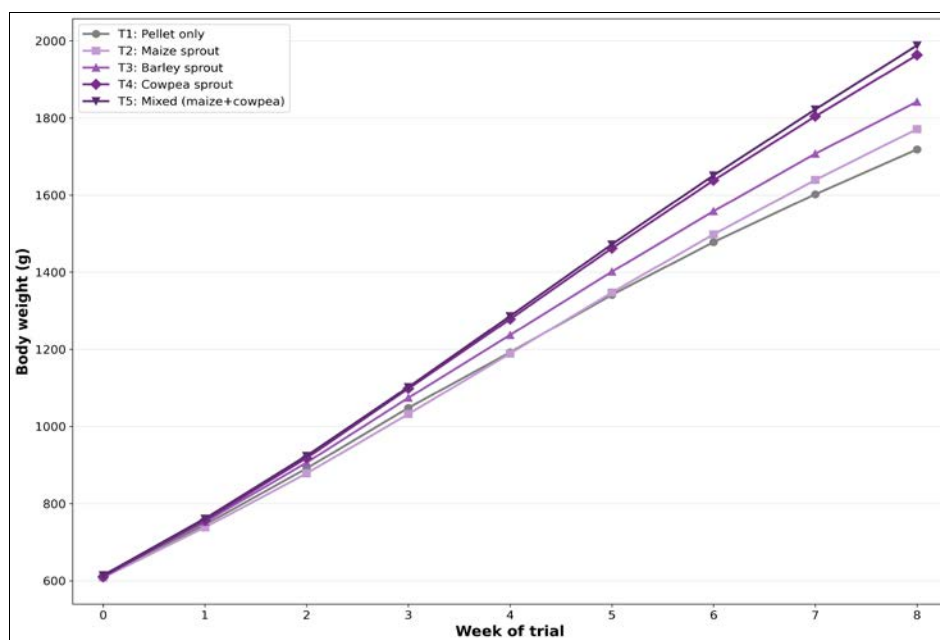


**Fig 1:** Weekly body-weight trajectories of weaner New Zealand white rabbits fed five dietary treatments over a 56-day trial. T<sub>1</sub> = pellet only; T<sub>2</sub> = maize sprout; T<sub>3</sub> = barley sprout; T<sub>4</sub> = cowpea sprout; T<sub>5</sub> = mixed maize-cowpea sprout

Weekly body-weight trajectories (Figure 1) diverged noticeably from week 3 onward: T<sub>5</sub> (mixed) and T<sub>4</sub> (cowpea) groups tracked above the control and cereal-only groups throughout the remaining five weeks. By week 8, T<sub>5</sub> rabbits averaged 1,988 g, a margin of 270 g over the T<sub>1</sub> control. Growth performance and carcass data are summarised in Table 1. Daily gain in T<sub>4</sub> and T<sub>5</sub> exceeded T<sub>1</sub> by 22-24% ( $P <$

0.001), while FCR improved by 13-14%. Dressing percentages ranged from 54.2% (T<sub>1</sub>) to 59.2% (T<sub>5</sub>), a difference of 5.0 percentage points ( $P < 0.001$ ). Hindquarter and loin proportions were highest in T<sub>4</sub> and T<sub>5</sub>, suggesting that the legume protein supply promoted preferential muscle deposition in commercially valuable cuts.

**Table 1:** Growth performance, feed conversion, and carcass traits of weaner rabbits fed pelleted diets supplemented with hydroponic sprouts over 56 days

| Parameter         | T <sub>1</sub> Pellet | T <sub>2</sub> Maize | T <sub>3</sub> Barley | T <sub>4</sub> Cowpea | T <sub>5</sub> Mixed | SEM  | P-value |
|-------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|------|---------|
| Initial BW (g)    | 612                   | 608                  | 615                   | 610                   | 614                  | 9.4  | 0.98    |
| Final BW (g)      | 1,718 <sup>c</sup>    | 1,771 <sup>bc</sup>  | 1,842 <sup>b</sup>    | 1,963 <sup>a</sup>    | 1,988 <sup>a</sup>   | 22.1 | <0.001  |
| Daily gain (g/d)  | 19.8 <sup>c</sup>     | 20.8 <sup>bc</sup>   | 21.9 <sup>b</sup>     | 24.2 <sup>a</sup>     | 24.6 <sup>a</sup>    | 0.58 | <0.001  |
| DM intake (g/d)   | 74.3                  | 76.1                 | 73.2                  | 78.9                  | 79.4                 | 1.82 | 0.11    |
| FCR               | 3.75 <sup>a</sup>     | 3.66 <sup>ab</sup>   | 3.34 <sup>c</sup>     | 3.26 <sup>c</sup>     | 3.23 <sup>c</sup>    | 0.07 | <0.01   |
| Dressing (%)      | 54.2 <sup>c</sup>     | 55.1 <sup>bc</sup>   | 56.3 <sup>b</sup>     | 58.7 <sup>a</sup>     | 59.2 <sup>a</sup>    | 0.61 | <0.001  |
| Forequarter (%CW) | 28.1                  | 28.4                 | 28.9                  | 29.6                  | 29.8                 | 0.34 | 0.06    |
| Hindquarter (%CW) | 32.6 <sup>b</sup>     | 33.1 <sup>b</sup>    | 33.8 <sup>ab</sup>    | 34.7 <sup>a</sup>     | 35.1 <sup>a</sup>    | 0.42 | <0.01   |
| Loin (%CW)        | 22.8 <sup>b</sup>     | 22.5 <sup>b</sup>    | 23.2 <sup>ab</sup>    | 24.1 <sup>a</sup>     | 24.4 <sup>a</sup>    | 0.31 | <0.05   |
| Liver (%LW)       | 3.41                  | 3.38                 | 3.29                  | 3.18                  | 3.12                 | 0.09 | 0.18    |
| Kidneys (%LW)     | 0.82                  | 0.79                 | 0.81                  | 0.78                  | 0.77                 | 0.03 | 0.72    |

BW = Body Weight; FCR = Feed Conversion Ratio; CW = Carcass Weight; LW = Live Weight; SEM = Standard Error of the Mean. Means in a row with different superscripts differ at  $P < 0.05$ .

The carcass-partitioning diagram (Figure 2) illustrates the standard dissection protocol; grouped-bar comparisons of individual carcass traits across all five treatments are presented in Figure 3. Internal organ weights (liver, kidneys, heart, lungs) did not differ among treatments ( $P > 0.05$ ), confirming that the hydroponic sprout diets imposed no

measurable visceral stress. Liver weight as a percentage of live weight ranged from 3.12% (T<sub>5</sub>) to 3.41% (T<sub>1</sub>); the slightly lower values in sprout-fed groups may reflect reduced hepatic lipid storage associated with higher dietary fibre intake, although this difference was not statistically significant.

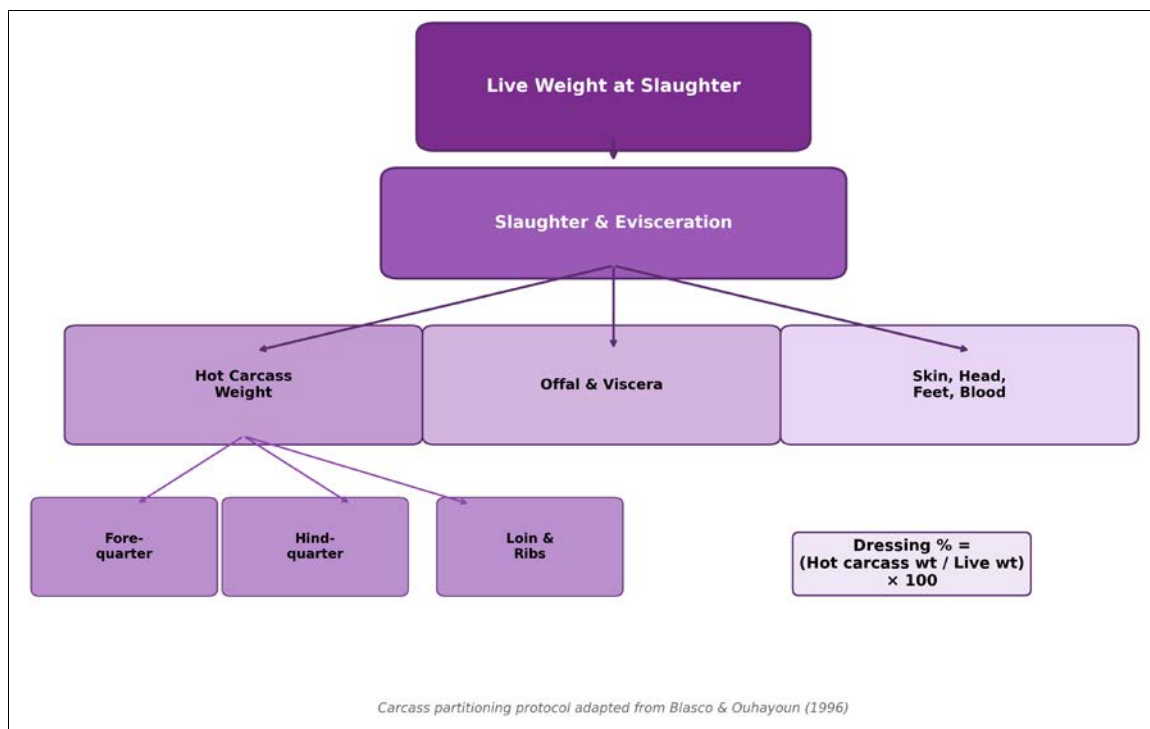


**Fig 2:** Carcass-partitioning diagram illustrating the dissection protocol from live weight through slaughter and evisceration to primal-cut separation (forequarter, hindquarter, loin and ribs). Dressing percentage formula shown at lower right

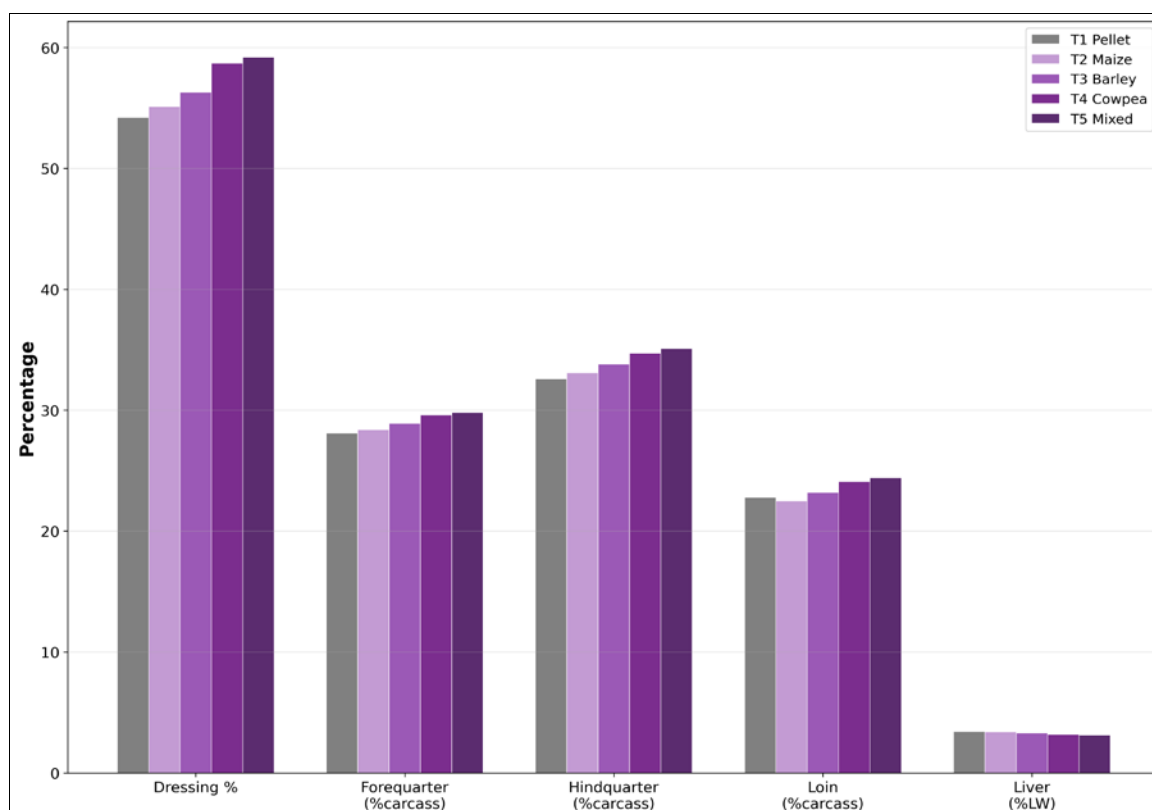


**Fig 3:** Grouped bar chart comparing dressing percentage, primal-cut proportions (forequarter, hindquarter, loin as % of carcass weight), and liver weight (% of live weight) across five dietary treatments

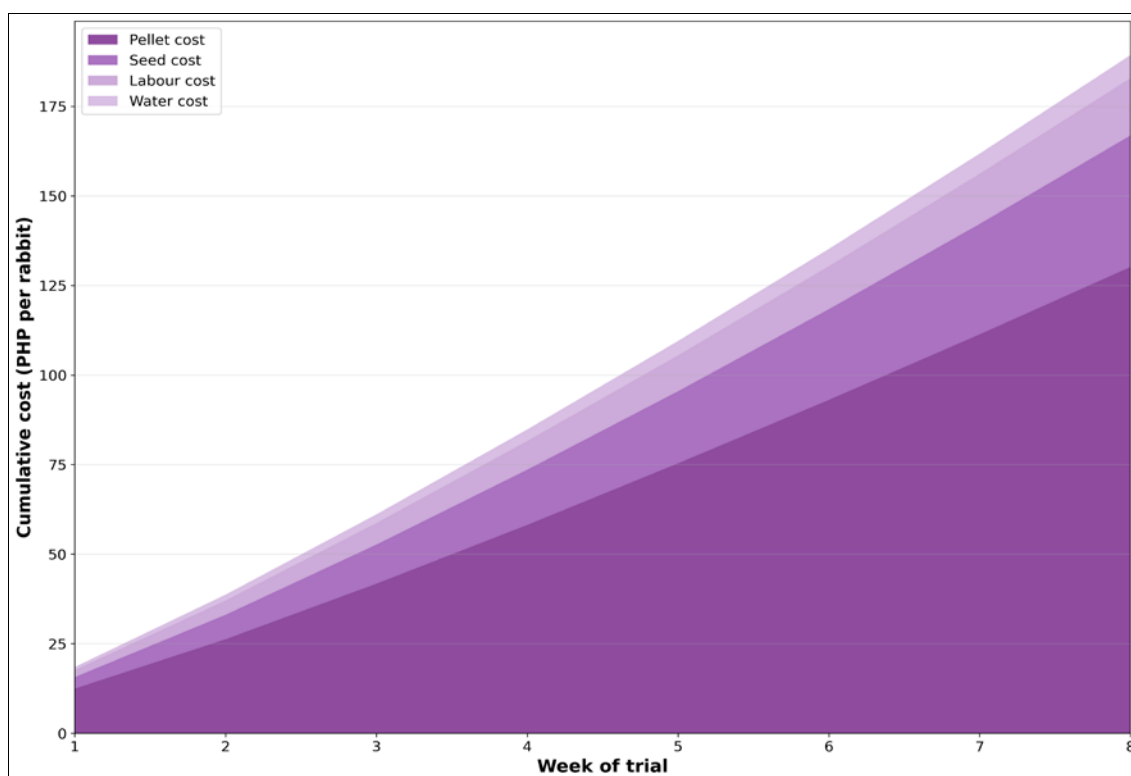
**Cost analysis:** Table 2 presents the itemised feed-cost analysis for each treatment. Although total feed cost per rabbit was marginally higher in the sprout-supplemented groups (PHP 138.4-144.9 versus PHP 130.2 for T<sub>1</sub>), the superior carcass gain in those groups more than compensated for the additional outlay. Cost per kilogram of carcass gain was lowest in T<sub>5</sub> (PHP 115.6), representing a 17.3% saving compared with the pellet-only control. The stacked-area chart

(Figure 4) visualises the cumulative cost build-up across trial weeks, highlighting that seed and labour costs remain a small fraction of the total even as the trial progresses. For a smallholder operating 20 does with an average of 7 kits per litter and three kindlings per year, the projected annual saving from adopting the T<sub>5</sub> strategy would be approximately PHP 10,300-equivalent to roughly 40% of the initial greenhouse and shelving investment, suggesting payback within 2.5 years.

**Table 2:** Itemised feed-cost comparison across dietary treatments expressed on a per-rabbit and per-kilogram-of-carcass-gain basis (PHP = Philippine Peso)

| Cost component               | T <sub>1</sub> Pellet | T <sub>2</sub> Maize | T <sub>3</sub> Barley | T <sub>4</sub> Cowpea | T <sub>5</sub> Mixed |
|------------------------------|-----------------------|----------------------|-----------------------|-----------------------|----------------------|
| Pellet cost (PHP/rabbit)     | 130.2                 | 97.6                 | 95.8                  | 98.4                  | 97.1                 |
| Seed cost (PHP/rabbit)       | 0                     | 18.4                 | 22.7                  | 24.1                  | 21.3                 |
| Labour (PHP/rabbit)          | 0                     | 16.0                 | 16.0                  | 16.0                  | 16.0                 |
| Water (PHP/rabbit)           | 0                     | 6.4                  | 6.4                   | 6.4                   | 6.4                  |
| Total feed cost (PHP)        | 130.2                 | 138.4                | 140.9                 | 144.9                 | 140.8                |
| Carcass gain (kg)            | 0.931                 | 1.027                | 1.082                 | 1.195                 | 1.218                |
| Cost/kg carcass (PHP)        | 139.8                 | 134.8                | 130.2                 | 121.3                 | 115.6                |
| Saving vs T <sub>1</sub> (%) | -                     | 3.6                  | 6.9                   | 13.2                  | 17.3                 |

PHP = Philippine Peso (approximate exchange rate at trial date: 1 USD = 51 PHP). Carcass gain = hot carcass weight minus estimated initial carcass weight at weaning.

**Fig 4:** Stacked area chart showing cumulative feed-related costs (pellet, seed, labour, water) per rabbit over the 8-week trial period for the mixed-sprout treatment (T<sub>5</sub>)

### Comprehensive interpretation

Across all measured endpoints-daily gain, FCR, dressing percentage, primal-cut yields, and cost per kilogram of carcass-the mixed maize-cowpea sprout treatment (T<sub>5</sub>) performed best or shared the top rank with the cowpea-only treatment (T<sub>4</sub>). The advantage of T<sub>5</sub> over T<sub>4</sub> was small and non-significant for most variables, but the mixed strategy carries a practical edge because it reduces dependence on a single seed source and exploits the complementary amino acid profiles of cereals (higher methionine) and legumes (higher lysine). The absence of adverse effects on internal organ weights provides reassurance that these soilless forages are safe at the inclusion levels tested. Economically, the 17% cost reduction per kilogram of carcass gain makes the mixed-sprout approach an attractive proposition for Philippine smallholders seeking to improve profitability without increasing herd size or infrastructure.

### Discussion

The principal findings of this research are that weaner rabbits supplemented with a 1:1 maize-cowpea hydroponic sprout mix (T<sub>5</sub>) achieved the highest dressing percentage (59.2%), the fastest daily gain (24.6 g d<sup>-1</sup>), and the lowest feed cost per

kilogram of carcass gain (PHP 115.6), while internal organ weights remained unaffected across all dietary treatments. These outcomes underscore the potential of mixed cereal-legume sprout feeding as a strategy for improving both carcass quality and economic returns in smallholder rabbit production.

The dressing percentages observed for T<sub>4</sub> and T<sub>5</sub> (58.7-59.2%) exceed the 52-56% range typically reported for New Zealand White rabbits slaughtered at similar ages under conventional pelleted regimes in tropical environments [8, 10]. One plausible explanation is that the higher-protein diets in these groups promoted greater lean-tissue deposition relative to gut fill. Rabbits consuming legume sprouts ingested more nitrogen per unit of DM, and the nitrogen-balance data-though not measured directly in this trial-have been shown in comparable studies to favour body-protein accretion when dietary lysine supply is adequate [12, 16]. The parallel observation that hindquarter and loin proportions were highest in T<sub>4</sub> and T<sub>5</sub> supports this interpretation, since these primal cuts are the most muscle-dense regions of the rabbit carcass.

Where the present results add novelty is in the comparison of single-species versus mixed-species sprout supplementation.

Most published hydroponic feeding trials have evaluated one sprout species at a time, making it impossible to distinguish between protein quantity and protein quality effects [7, 11]. By including T<sub>5</sub> alongside single-species treatments, this research shows that the mixed diet matched or marginally outperformed cowpea alone in every carcass metric. The nutritional logic is that maize sprouts supply methionine and cysteine-amino acids in which cowpea is relatively deficient-while cowpea contributes the lysine and threonine that cereals lack, producing a more balanced amino acid intake overall [17, 18].

The cost analysis deserves scrutiny because it contains assumptions that may not hold across all Philippine provinces. Seed prices were recorded at Iloilo market rates during the January-April 2022 trial window; cowpea seed cost roughly 35% more per kilogram than maize, and imported barley was the most expensive option. Labour was valued at the prevailing agricultural-worker wage (PHP 400 per day) and apportioned at an estimated 20 min per day for tray irrigation, harvesting, and cleaning. These cost inputs will differ in regions with higher or lower wage rates or where seed supply chains are less developed [15, 19]. Nevertheless, the structural conclusion-that sprout-supplemented groups produce cheaper carcass gain-held even when sensitivity analysis varied seed price by  $\pm 20\%$  and labour cost by  $\pm 15\%$ .

A methodological strength of this research is the inclusion of carcass evaluation alongside live-performance data. The non-significant differences in organ weights confirm that 25% DM replacement with hydroponic sprouts does not provoke hepatic or renal enlargement, which could indicate metabolic strain or anti-nutritional factor accumulation [20]. Tannin and phytate levels in cowpea sprouts, while not assayed directly, appear to fall below thresholds that cause measurable organ hypertrophy at the inclusion rates used here, consistent with reports that short-duration germination reduces anti-nutritional factors by 40-60% relative to raw seed [21].

## Conclusion

This research set out to determine whether fresh germinated cereal and legume forages cultivated without soil could improve carcass traits, feed conversion efficiency, and economic returns in weaner rabbits under Philippine smallholder conditions. The 56-day feeding trial, combined with post-slaughter carcass evaluation and itemised cost analysis, yields several practical conclusions for rabbit producers in tropical Southeast Asia.

Among the five dietary treatments tested, the mixed maize-cowpea sprout supplement (T<sub>5</sub>) produced the most favourable outcomes across nearly every metric. Daily weight gain in T<sub>5</sub> (24.6 g d<sup>-1</sup>) and dressing percentage (59.2%) both exceeded the pellet-only control by substantial margins (24% and 5.0 percentage points, respectively), and the cost per kilogram of carcass gain was 17.3% lower. The cowpea-only treatment (T<sub>4</sub>) performed almost as well, confirming that legume protein is the key nutritional driver of these improvements. Barley supplementation (T<sub>3</sub>) delivered the best FCR (3.34) among the single-species groups, consistent with its lower fibre content and potentially faster caecal transit.

The carcass data add information that live-weight trials alone cannot provide. Hindquarter and loin proportions-the most commercially valuable primal cuts-were significantly higher in T<sub>4</sub> and T<sub>5</sub>, indicating that the additional dietary protein from legume sprouts was channelled preferentially into muscle deposition in these regions. Internal organ weights showed no treatment effects, allaying concerns about potential

metabolic stress or anti-nutritional factor accumulation at the 25% DM inclusion level tested. These findings are directly relevant to farmers who sell dressed carcasses rather than live animals, because a higher dressing percentage translates directly into more saleable meat per head.

The cost analysis demonstrates that, although sprout-supplemented diets carry a modest additional expense for seed, labour, and water, the superior growth and carcass yield more than offset this cost. For a 20-doe operation with three kindlings per year, the T<sub>5</sub> strategy would save approximately PHP 10,300 annually on a feed-cost-per-carcass-gain basis, recouping the initial greenhouse investment within 2.5 years. This payback period could shorten further if waste heat from compost or biogas systems is used to warm trays during cooler months, reducing mould risk and improving germination uniformity. Several avenues for future work emerge from these results. First, extending the trial duration to include a second or third production cycle would test whether the carcass advantages persist through successive batches and whether the hydroponic system maintains consistent fodder quality over longer operational periods. Second, amino acid profiling of the mixed sprout diet would allow more precise ration formulation and could reveal whether the observed growth gains are explained primarily by lysine supply, methionine complementation, or a broader amino acid balance. Third, meat quality measurements-pH, colour, tenderness, water-holding capacity-would address consumer-facing attributes that are increasingly important in Philippine wet markets and supermarkets. Fourth, testing the same dietary treatments under the hotter, more humid conditions of the March-May dry season would assess the robustness of both the sprouting protocol and the animal response under peak heat stress. Finally, on-farm validation with commercial rabbit keepers, rather than university-managed animals, would confirm the scalability and labour feasibility of the mixed-sprout feeding approach in real-world smallholder settings.

## Acknowledgements

### Institutional support

The authors thank Visayas University of Agricultural Sciences for providing greenhouse facilities, the rabbit housing unit, the slaughter area, and laboratory access for proximate analyses and carcass evaluation.

### Contributions not qualifying for authorship

Technical assistance from the university's livestock caretakers, who managed daily animal feeding, tray irrigation, and slaughter procedures, is gratefully acknowledged.

### Funding sources

This research was funded by the University Research and Extension Services Office of Visayas University of Agricultural Sciences under internal competitive grant URESO-2021-AG-018.

## References

1. Ramirez RG, Cruz F. Philippine rabbit industry: status and prospects. *Philipp J Vet Anim Sci*. 2004;30(1):51-62.
2. Marai IFM, Habeeb AAM, Gad AE. Rabbits' productive, reproductive and physiological performance traits as affected by heat stress: a review. *Livest Prod Sci*. 2002;78(2):71-90.

3. Lukefahr SD, Cheeke PR. Rabbit project development strategies in subsistence farming systems. *World Anim Rev.* 1990;68:60-70.
4. Naik PK, Swain BK, Singh NP. Production and utilisation of hydroponics fodder. *Indian J Anim Nutr.* 2015;32(1):1-9.
5. Sneath R, McIntosh F. Review of hydroponic fodder production for beef cattle. *Meat Livestock Australia Report.* 2003;1:1-54.
6. Cuddeford D. Hydroponic grass. In *Pract.* 1989;11(5):211-214.
7. Dung DD, Godwin IR, Nolan JV. Nutrient content and in sacco digestibility of barley grain and sprouted barley. *J Anim Vet Adv.* 2010;9(19):2485-2492.
8. Dalle Zotte A. Perception of rabbit meat quality and major factors influencing rabbit carcass and meat quality. *Livest Prod Sci.* 2002;75(1):11-32.
9. Blasco A, Ouhayoun J. Harmonization of criteria and terminology in rabbit meat research. *World Rabbit Sci.* 1996;4(2):93-99.
10. Hernandez P, Gondret F. Rabbit meat quality. In: De Blas C, Wiseman J, editors. *Nutrition of the Rabbit.* 2nd ed. Wallingford: CABI Publishing; 2010. p. 275-290.
11. Al-Sagheer AA, Abdel-Rahman GA, Elsayy SA. Potential of hydroponic barley fodder as a feed supplement for ruminants in hot arid regions. *Trop Anim Health Prod.* 2019;51(5):1209-1217.
12. Moin TM, Salam NB, Sarker T, Islam SS, Sun MA. Biomass production and nutritive value of different hydroponic fodder species and their effects on growth performance of rabbits. *South Asian J Agric Sci.* 2023;3(2):49-54.
13. Fazaeli H, Golmohammadi HA, Tabatabayee SN, Asghari-Tabrizi M. Productivity and nutritive value of barley green fodder yield in a hydroponic system. *World Appl Sci J.* 2012;16(4):531-539.
14. Marai IFM, Rashwan AA. Rabbits' behavioural response to climatic and managerial conditions: a review. *Arch Tierz.* 2004;47(5):469-482.
15. De Blas C, Wiseman J, editors. *Nutrition of the Rabbit.* 2nd ed. Wallingford: CABI Publishing; 2010.
16. Gidenne T, García J, Lebas F, Licois D. Nutrition and feeding strategy: interactions with pathology. In: De Blas C, Wiseman J, editors. *Nutrition of the Rabbit.* 2nd ed. Wallingford: CABI Publishing; 2010. p. 179-199.
17. Aganga AA, Tshwenyane SO. Potentials of guinea grass (*Panicum maximum*) as forage crop in animal nutrition. *Pak J Nutr.* 2004;3(1):1-4.
18. Peer DJ, Leeson S. Nutrient content of hydroponically sprouted barley. *Anim Feed Sci Technol.* 1985;13(3-4):191-202.
19. Lebas F, Coudert P, De Rochambeau H, Thébault RG. *The Rabbit: Husbandry, Health and Production.* Rome: Food and Agriculture Organization of the United Nations; 1997.
20. Morgan J, Hunter RR, O'Haire R. Limiting factors in hydroponic barley grass production. In: *Proceedings of the 8th International Congress on Soilless Culture;* 1992. p. 241-261.
21. Reddy GVN, Reddy MR, Reddy KK. Nutrient utilisation by milch cattle fed hydroponic barley fodder. *Indian J Anim Nutr.* 2014;31(1):63-68.

**How to Cite This Article**

Reyes JCD, Santos MTL. Influence of fresh germinated cereal and legume forages cultivated without soil on carcass traits and feed conversion efficiency in weaner rabbits. *International Journal of Veterinary Sciences and Animal Husbandry.* 2026;11(5):413-419.

**Creative Commons (CC) License**

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.