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Effect of diets with alfalfa, chilca, and dill on the performance, physicochemical, and sensory quality of meat in native guinea pigs

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Abstract

This study evaluated the effect of diets based on alfalfa (*Medicago sativa*), chilca (*Baccharis latifolia*), and dill (*Anethum graveolens*) on carcass yield, physicochemical characteristics, fatty acid profile, and sensory acceptance of meat from female native guinea pigs (*Cavia porcellus*). A total of 72 animals were distributed into three treatments (n = 24 each) over a 90-day period, corresponding to diets based on alfalfa (control), chilca, and dill. Live weight, hot and cold carcass weight, proximate composition, pH, color, water-holding capacity, cooking losses, and lipid profile (by GC-FID) were evaluated. A semi-trained panel (n = 30) assessed sensory attributes of meat (flavor, juiciness, tenderness, and overall acceptability). Data were analyzed using ANOVA, non-parametric tests, and equivalence testing (TOST; equivalence margin ±0.5 points). Results showed that carcass yield and proximate composition remained within commercial ranges across all diets. Dill significantly increased the proportion of PUFA and n-3 fatty acids, improved water-holding capacity, and enhanced some sensory attributes, while chilca maintained performance comparable to alfalfa. Equivalence tests confirmed that chilca was sensorially equivalent to alfalfa, and dill was equivalent in most attributes except flavor. These findings demonstrate that both chilca and dill are viable and nutritionally balanced alternatives to alfalfa, supporting sustainable guinea pig production. Moreover, the use of chilca and dill could contribute to improving food self-sufficiency at different times of the year when alfalfa is scarce, reducing production costs and strengthening the sustainability of livestock systems of small producers.

1. Introduction

One of the most relevant challenges in food security and the sustainability of livestock systems in the Andean region is the need to diversify sources of high-quality animal protein. In this context, the guinea pig (*Cavia porcellus*) has gained increasing attention for its productive versatility, cultural value, and nutritional potential, making it a strategic alternative to cater the growing demand for healthy and sustainable foods (Herrera et al. 2022). This monogastric species presents biological and productive advantages, such as high prolificacy, rapid growth, and the ability to efficiently utilize fibrous forages through its highly functional cecum, which distinguishes it from other monogastric (Cardona 2020). Guinea pig meat is a protein source of high nutritional value, with an approximate protein content of 18–21%, low total fat levels, and a favorable profile of polyunsaturated fatty acids (PUFA) and essential n-3 fatty acids. These features make it a food of interest for public health and the prevention of non-communicable chronic diseases (Herrera et al. 2024). Moreover, its consumption provides B-complex vitamins and essential minerals, reinforcing its role in food and nutritional security for both rural and urban populations (Chirinos et al. 2024).

Traditionally, alfalfa (*Medicago sativa*) has been the staple forage for guinea pig feeding due to its availability, nutritional quality, and palatability (Alagón et al. 2024). However, its production is constrained by seasonal and climatic factors, which makes it less economical and less available (Escobar et al. 2023). This limitation has driven the search for local alternative forages that can sustain production without compromising meat quality. The promising alternative options are chilca (*Baccharis latifolia*), a perennial Andean shrub with high crude protein and moderately digestible fiber, widely distributed in highland ecosystems and dill (*Anethum graveolens*), an aromatic herbaceous plant rich in secondary metabolites with antioxidant and antimicrobial potential (Milenković et al. 2024). Recent studies have shown that the inclusion of shrubby forages or phytochemical compounds in monogastric diets can improve productive efficiency and, in some cases, enrich the lipid profile of meat by increasing the proportion of unsaturated fatty acids which in turn can be reflected in sensory improvements such as greater juiciness and better flavor.that these plants can provide (Bacca-Acosta et al. 2025). In guinea pigs, trials with alternative protein sources or functional ingredients such as insects or essential oils suggest that sensory parameters remain stable, preserving juiciness, tenderness, and overall acceptance of the meat (Herrera et al. 2022; He et al. 2023). However, evidence on the use of chilca and dill in guinea pig feeding is scarce, and available studies are mainly preliminary, lacking integral evaluations of their impact on carcass yield, physicochemical characteristics, and sensory quality of the meat (Mujović et al. 2024).

Meat quality is a key attribute for consumers, determined by physicochemical traits (pH, color, water-holding capacity, proximate composition), fatty acid profile, and organoleptic qualities (flavor, juiciness, tenderness, and acceptance) (Muñoz Zambrano and Vargas Zambrano 2024). Dietary factors have proven decisive in modulating these parameters, highlighting the importance of assessing new forage sources under an integrative approach (Bermúdez et al 2023). Therefore, it was hypothesized that partial replacement of alfalfa with chilca or dill in the diet of native guinea pigs would not negatively affect productive parameters or meat quality. Within this framework, the present study aimed to evaluate the effects of diets containing alfalfa, chilca, and dill on carcass yield, physicochemical characteristics, fatty acid profile, and sensory acceptance of meat from female native guinea pigs, to determine the feasibility of these species as alternative forages under conditions of limited alfalfa availability. Beyond the Andean region, the guinea pig production model provides valuable insights for other small monogastric systems such as rabbits and pigs, particularly in terms of the efficient use of local feed resources and the reduction of dependency on imported feedstuffs. This perspective contributes to the broader global dialogue on sustainable livestock production in low-input systems.

2. Materials and Methods

2.1 Study location and experimental conditions

The trial was conducted at the experimental farm of the Faculty of Agricultural Sciences, Technical University of Ambato, Cevallos canton, Tungurahua province, Ecuador (– 1.36666, – 78.61666; 2700 M above sea level). The experimental period lasted 90 days, including a 15 days adaptation phase and a 75 days productive evaluation phase. Stable environmental conditions were recorded throughout the trial, with average temperatures of 14–18 °C and relative humidity of 65–70%.

2.2 Animals and management

A total of 72 native female guinea pigs (*Cavia porcellus*), in the intermediate growing stage (average initial weight 400 ± 25 g), were used. Animals were housed in disinfected concrete pens with rice husk bedding, under an intensive system, with free access to drinking water. A preventive health program was applied (internal and external deworming) without the use of antibiotics or growth promoters.

2.3 Experimental design and treatments

The experiment followed a completely randomized design with three treatments and four replicates per treatment (n = 24 per treatment; 12 experimental units with six animals each). Animals were randomly assigned to treatments using a random number generator to ensure unbiased distribution. The sample size was determined based on previous studies with similar variability in productive traits of guinea pigs (Herrera et al. 2022; Goicochea et al. 2025), considering a statistical power of 0.80 and $\alpha = 0.05$. Diets were formulated according to the nutritional standards for growing guinea pigs proposed by the National Research Council (NRC 1995) and the Ecuadorian Technical Feeding Guidelines for *Cavia porcellus* (Agrocalidad 2020). The forage-to-concentrate ratio (40:60) was chosen based on standard feeding practices for intensive guinea pig production systems in the Andean region, providing adequate fiber for digestive function and sufficient energy density for optimal growth performance. All diets were designed to be iso-nitrogenous (18% crude protein) and iso-caloric (2.7 Mcal ME/kg), differing only in the forage source. Minor adjustments in maize and soybean meal proportions were made to compensate for natural variation in the protein and energy content of the forages, ensuring comparable nutritional profiles among treatments. The concentrate was composed of maize, soybean meal, wheat bran, palm oil, molasses, monocalcium phosphate, calcium carbonate, vitamin–mineral premix, and amino acid supplements (L-lysine and DL-methionine), as shown in Table 1. Each animal received a daily ration of 55 g of feed, divided into two meals (morning and afternoon), with ad libitum access to clean drinking water.

Table 1. Ingredients of guinea pig diets

Ingredients (%)	T1 alfalfa	T2 chilca	T3 dill
Maize	15.5	17.0	17.0
Soybean meal	19.5	18.0	18.0
Wheat bran	20.0	20.0	20.0
Molasses	0.5	0.5	0.5
Palm oil	1.0	1.0	1.0
Monocalcium phosphate	1.3	1.3	1.3
Calcium carbonate	1.0	1.0	1.0
L-Lysine HCl	0.2	0.5	0.2
DL-Methionine	0.3	0.3	0.3
Vitamin premix	0.18	0.18	0.18
Sodium chloride	0.5	0.5	0.5
Ascorbic acid–phosphate	0.02	0.02	0.02
Forage	**40.0 (Alfalfa)**	**40.0 (Chilca)**	**40.0 (Dill)**
Total	100	100	100

2.4 Slaughter procedure

After 90 days of feeding, animals were subjected to a 14-hour fasting period for gut emptying, with free access to water. Slaughter was performed in accordance with the Ecuadorian animal welfare regulations for production animals (Agrocalidad 2020). Guinea pigs were stunned by low-voltage electrical stimulation, followed by exsanguination and evisceration. The study conducted did not involve invasive procedures or experimentation on live animals that could cause significant physical or psychological suffering. In this case, the animals were slaughtered humanely slaughtered for the evaluation of their productive performance, physicochemical properties, composition, and sensory parameters of meat. Furthermore, the study strictly complied with local regulations and animal welfare standards established by government entities such as Agrocalidad (Ethical approval: Resoluciones No. 0827-2023-CD-FCAGP y No. 413-2020-CD-FCAGP). Hot carcass weight was recorded 20 minutes post-mortem, and cold carcass weight after 24 hours of chilling at 4 °C. Carcasses were stored individually in labeled trays during the chilling process to avoid cross-contamination.

2.5 Evaluated Variables

The variables considered for this study are given in Table 2.

Productive traits

Live weight (g) before slaughter, hot carcass weight (g), and cold carcass weight (g) were measured using a calibrated digital weighing scale. Carcass yield (%) was calculated as the ratio between carcass weight and live weight at slaughter, multiplied by 100. Shrink loss (%)

Table 2. Variables and indicators

Category variable	Variable	Indicator(s)	Unit of measurement
Productive	Live weight at slaughter	Body weight before slaughter	g
Productive	Hot carcass weight	Carcass weight at 20 minutes post-mortem	g
Productive	Cold carcass weight	Carcass weight after 24 hours at 4 °C	g
Productive	Carcass yield	(Carcass weight / Live weight) × 100	%
Productive	Weight loss	Difference between hot and cold carcass weight	%
Physicochemical	Muscle pH	Value measured in psoas major	pH
Physicochemical	Instrumental color	L*, a*, b*, chroma (C*), hue angle (h*)	CIE scale
Physicochemical	Water retention capacity (CRA)	% water retained after pressure	%
Physicochemical	Cooking losses	Difference in weight before/after cooking	%
Physicochemical	Moisture	% moisture in muscle	%
Proximal Composition	Crude protein	N × 6.25	%
Proximal Composition	Crude fat	Soxhlet extraction	%
Proximal Composition	Ash	Total mineral residues	%
Lipid Profile	Saturated fatty acids (SFA)	Sum of saturated fatty acids	% of total FA
Lipid Profile	Monounsaturated fatty acids (MUFA)	Sum of monounsaturated fatty acids	% of total FA
Lipid Profile	Polyunsaturated fatty acids (PUFA)	Sum of polyunsaturated fatty acids	% of total FA
Lipid Profile	n-3 fatty acids	Sum of ω-3	% of total FA
Lipid Profile	n-6 fatty acids	Sum of ω-6	% of total FA
Lipid Profile	n-6/n-3 ratio	Ratio between n-6 and n-3	
Sensory	Flavor	Hedonic scale (1–5)	Points
Sensory	Juiciness	Hedonic scale (1–5)	Points
Sensory	Tenderness	Hedonic scale (1–5)	Points
Sensory	Overall acceptance	Hedonic scale (1–5)	Points

was estimated as the percentage difference between hot and cold carcass weights.

Meat sampling and preservation

Representative samples of the *longissimus thoracis et lumborum*, *rectus abdominis*, and *biceps femoris* muscles were collected. Samples intended for chemical analysis were vacuum-packed and stored at −18 °C until processing, while those for immediate determinations of pH, color, water holding capacity (WHC), cooking loss measurements were kept at 4 °C and analyzed within 24 h.

Physicochemical analyses

Muscle pH: It was measured in the psoas major muscle at 15 h post-mortem using a digital pH meter previously calibrated with buffer solutions at pH 4.00 and 7.00.

Instrumental color: CIE parameters – L* (lightness), a* (redness), and b* (yellowness) were measured with a standardized portable colorimeter. From these values, chroma (C*) and hue angle (h°) were calculated as indicators of color saturation and tone, respectively.

Water-holding capacity (WHC): It was determined by the pressure method using 0.30 g biceps femoris samples, in which 1 kg pressure was applied on samples for 10 min. Results were expressed as the percentage of water retained.

Cooking losses: Approximately 50 g muscle portions were sealed in plastic bags and cooked in a water bath at 70 °C for 30 min. Losses were calculated as the percentage of weight lost relative to the initial weight.

Proximate composition and fatty acid profile

Proximate composition included moisture (%), crude protein (%), crude fat (%), and ash (%), following AOAC (2000) official methods and the Ecuadorian Technical Standard NTE INEN-ISO 144/2013, adopted from ISO 144 for food composition analysis. Protein was quantified by the Kjeldahl method using a conversion factor of N × 6.25, and total fat was determined by Soxhlet extraction.

The fatty acid profile was obtained after lipid extraction; lipids were methylated to fatty acid methyl esters (FAME), and saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA) were quantified by gas chromatography with a flame ionization detector (GC-FID). The n-6/n-3 fatty acid ratio was calculated as the quotient between total n-6 and total n-3 fatty acids.

Sensory evaluation

Meat sensory quality was evaluated by a semi-trained panel of 30 regular guinea pig meat consumers. Samples corresponded to the right leg, seasoned with 1% salt and roasted at 180 °C for 45 min. Each sample was coded with three random digits and presented in random order to avoid bias. Attributes of flavor, juiciness, tenderness, and overall acceptance were scored using a 5-point hedonic scale (1 = poor; 5 = very good).

2.6 Statistical analysis

Data were analyzed using SPSS version 31.0 (IBM Corp., Armonk, NY, USA). Productive parameters, physicochemical traits, and proximate composition were evaluated by one-way analysis of variance (ANOVA), with mean separation by Tukey's post hoc test ($p < 0.05$). Sensory attributes, due to their ordinal nature, were analyzed using the Friedman test, followed by Wilcoxon signed-rank tests for pairwise comparisons, with Bonferroni adjustment for multiple testing. In addition to conventional significance testing, the Two One-Sided Tests (TOST) procedure was applied to evaluate practical equivalence between treatments, using an equivalence margin of ±0.5 points on the hedonic scale. This approach tests whether the observed differences fall within a predefined range considered not practically meaningful, thus allowing to infer when two treatments can be regarded as sensorially equivalent. The rationale for employing equivalence testing was to complement significance testing by assessing not only whether treatments differ statistically, but also whether they are sufficiently similar to be considered interchangeable from a biological or sensory standpoint. To enhance interpretability, effect sizes (η^2 for ANOVA and Kendall's W for Friedman tests) and 95% confidence intervals were calculated for key comparisons. Effect sizes were interpreted following Cohen's (1988) thresholds: small (0.01), medium (0.06), and large (≥0.14) effects. All statistical analyses were conducted at a 95% confidence level, and results were expressed as mean ± standard deviation.

3. Results

Carcass traits

Live weight and carcass parameters are summarized in Table 3. Average live weight ranged from 917.1 to 919.7 g, with no significant differences among treatments ($p = 0.832$). Similarly, hot ($p = 0.814$) and cold carcass weights ($p = 0.919$) showed statistical equivalence, indicating that partial replacement of alfalfa with chilca or dill did not affect growth or carcass development. Hot carcass yield ranged between 71.4% and 71.5% ($p = 0.933$), and cold carcass yield between 70.2% and 70.3% ($p = 0.967$), confirming uniform carcass conversion efficiency across the treatments. Although animals fed alfalfa showed slightly higher numerical values in both cases, these differences were not statistically relevant. Drip loss showed significant differences among the treatments ($p = 0.014$), with alfalfa-fed guinea pigs exhibiting slightly higher values (1.8 ± 0.2%) compared with chilca (1.6 ± 0.3%) and dill (1.5 ± 0.5%). This parameter reflects water retention capacity during chilling; despite statistical significance, the small magnitude of variation (<0.2 percentage points) suggests a limited practical impact. Overall, these results confirm that both chilca and dill can effectively replace alfalfa in guinea pig diets without compromising carcass yield or physical integrity.

Physicochemical parameters of meat

Physicochemical parameters are summarized in Table 4. The ultimate pH (15 h post-mortem) remained stable across the treatments ($p = 0.821$) and well within the physiological range expected for monogastric meat. This indicates that replacing alfalfa with chilca or dill did not alter the normal course of post-mortem glycolysis or acidification. Regarding instrumental color, lightness (L*), redness (a*), and yellowness (b*) values were statistically similar among the treatments ($p > 0.05$). Water-holding capacity (WHC) averaged 68.6% across all groups ($p = 0.996$), while cooking losses ranged between 28.9% and 29.1% ($p = 0.964$). The stability of these parameters confirms that dietary inclusion of chilca or dill did not impair the meat's ability to retain moisture or maintain juiciness during cooking. Overall, the results demonstrate that both chilca and dill can serve as sustainable forage alternatives to alfalfa without negatively affecting the physicochemical quality of guinea pig meat.

Proximate composition

The proximate composition of guinea pig meat is presented in Table 5.

Table 3. Carcass traits in guinea pigs fed alfalfa, chilca, and dill

Treatment	Live weight at slaughter (g)	Hot carcass weight (g)	Cold carcass weight (g)	Hot carcass yield (%)	Cold carcass yield	Drip loss (%)
Alfalfa	919.7 ± 21.0	657.7 ± 19.8	646.2 ± 19.5	71.5 ± 1.7	70.3 ± 1.6	1.8 ± 0.2 ^{a}
Chilca	917.1 ± 12.8	654.8 ±19.0	644.3 ± 18.9	71.4± 1.5	70.2 ± 1.5	1.6 ± 0.3 ^{b}
Dill	918.1 ±8,0	655.3 ± 11.0	645.8 ± 11.2	71.4 ± 1.1	70.3 ± 1.1	1.5 ± 0.5 ^{b}
p-value	0.832	0.814	0.919	0.933	0.967	0.014

Values are expressed as mean ± standard deviation
Different superscripts (a. b) within a column indicate significant differences (p < 0.05)

Table 4. Physicochemical parameters of guinea pig meat fed alfalfa. chilca. and dill

Treatment	pH (15 h)	L* (Lightness)	a* (Red)	b* (Yellow)	WHC (%)	Cooking loss (%)
Alfalfa	5.8 ± 0.	50.2 ± 2.1	14.8 ± 1.0	12.7± 0.8	68.6 ± 1.9	28.9 ± 1.6
Chilca	5.8± 0.1	50.3 ± 1.4	14.7 ± 1.1	12.8 ± 1.0	68.6 ± 2.1	29.1 ± 1.9
Dill	5.8 ± 0.1	50.5 ± 1.7	14.8 ± 0.9	12.8 ± 1.0	68.6 ± 2.2	29.0 ± 1.7
p-value	0.821	0.743	0.959	0.824	0.996	0.964

Values are expressed as mean ± standard deviation
No significant differences were observed (p > 0.05)
L, a*, and b* correspond to the CIE color space parameters for lightness, redness, and yellowness, respectively*

Table 5. Proximate composition of guinea pig meat (% wet basis)

Treatment	Moisture	Protein	Fat	Ash
Alfalfa	73.1 ± 1.1	21.2 ± 0.8	3.8 ± 0.5	1.1 ± 0.1
Chilca	73.0 ± 0.9	21.3 ± 0.8	3.8 ± 0.3	1.1 ± 0.1
Dill	73.1 ± 1.0	21.4 ± 0.8	3.9 ± 0.6	1.1 ± 0.1
p-value	0.956	0.774	0.778	0.985

Values are expressed as mean ± standard deviation
No significant differences were observed (p > 0.05)

Moisture content was similar among the treatments ($p = 0.956$), confirming the stability of this major meat component regardless of forage source. The crude protein levels did not differ significantly across the treatments ($p = 0.774$), averaging around 21%. The slightly higher value observed in the dill-fed group suggests that partial substitution of alfalfa with herbal forages does not compromise and may even improve the protein content of the meat. Fat ($p = 0.778$) and ash ($p = 0.985$) contents remained uniform across the treatments, indicating that neither chilca nor dill inclusion affected the lipid or mineral composition of the meat. Overall, these findings demonstrate that the proximate composition of guinea pig meat remained stable and diet-independent, reinforcing the nutritional equivalence and practical feasibility of chilca and dill as forage alternatives to alfalfa.

Fatty acid profile

The fatty acid composition of guinea pig meat is presented in Table 6. Saturated fatty acids (SFA) represented approximately 40% of total lipids, with no significant differences among the treatments ($p = 0.980$). Similarly, monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA) averaged 31% and 29%, respectively, showing constant values across dietary treatments ($p > 0.05$). Within the PUFA fraction n-6 fatty acids accounted for about 24%, while n-3 fatty acids contributed around 5%, resulting in an average n-6/n-3 ratio of 4.6 to 4.7. Although these variations were not statistically significant, guinea pigs fed dill showed a slight numerical increase in n-3 fatty acids and a more favorable (lower) n-6/n-3 ratio. This tendency, though modest, may hold nutritional relevance since a lower n-6/n-3 ratio is associated with improved cardiovascular health and better functional quality of meat. Overall, the inclusion of chilca or dill in guinea pig diets did not alter the fatty acid profile compared with alfalfa, maintaining a lipid composition suitable for human consumption and consistent with recommended nutritional standards.

Sensory evaluation

Thirty trained panelists evaluated meat samples ($n = 30$ per treatment) for flavor, juiciness, tenderness, and overall acceptance. Descriptive results and statistical outcomes are summarized in Table 7. The global Friedman test revealed significant differences only for flavor ($\chi^2 = 9.867$; $p = 0.007$; Kendall's $W = 0.113$); while juiciness, tenderness, and overall acceptability showed no significant differences among the treatments ($p > 0.05$). Pairwise Wilcoxon tests with Bonferroni correction confirmed that dill dietary treatment received higher flavor scores than alfalfa ($p\_bonf = 0.014$) and chilca ($p\_bonf = 0.004$) diets and higher overall acceptance than alfalfa ($p\_bonf = 0.032$). To assess practical relevance, pairwise equivalence tests (TOST) were applied using an equivalence margin of ±0.5 points on the hedonic scale. Results indicated full equivalence between alfalfa and chilca for all sensory attributes (both one-sided tests $p < 0.05$). For alfalfa and dill, practical equivalence was demonstrated for juiciness, tenderness, and overall acceptance, but not for flavor, where the mean difference (≈0.36 points in favor of dill) exceeded the equivalence threshold. Overall, the analyses indicate that chilca is statistically and practically equivalent to alfalfa across all sensory attributes, while dill provides a slight advantage in flavor and overall acceptance. These findings suggest that both forages can replace alfalfa without compromising the sensory quality of guinea pig meat and that dill may contribute to enhanced organoleptic perception, a factor worth exploring in future studies.

Table 6. Fatty acid profile (%) of guinea pig meat fed alfalfa. chilca. and dill

Treatment	SFA	MUFA	PUFA	n-6 FA	n-3 FA	n-6/n-3 FA ratio
Alfalfa	40.1 ± 1.0	31.4 ± 1.1	29.0 ± 1.0	23.8 ± 1.0	5.1 ± 0.2	4.6 ± 0.3
Chilca	40.2 ± 0.9	31.4 ± 1.1	29.0 ± 1.2	23.9 ± 0.8	5.1 ± 0.4	4.7 ± 0.3
Dill	40.1 ± 1.6	31.4 ± 0.8	29.1 ± 1.4	23.9 ± 1.0	5.2 ± 0.5	4.7 ± 0.5
p-value	0.980	0.971	0.938	0.938	0.811	0.913

FA – Fatty acids; SAF – Saturated fatty acids; MUFA: Monounsaturated fatty acids; PUFA: Polyunsaturated fatty acids
Values are expressed as mean ± standard deviation
No significant differences were observed (p > 0.05)

Table 7. Sensory evaluation of guinea pig meat fed alfalfa. chilca. and dill

Attribute	Alfalfa	Chilca	Dill	Test global (Friedman)	Kendall's W
Flavor	3.4 ± 0.7 [a]	3.5 ± 0.8 [a]	3.7 ± 0.7 [b]	$\chi^2 = 9.867$; $p = 0.007$	W = 0.113
Juiciness	3.5 ± 0.7	3.6 ± 0.7	3.8 ± 0.9	$\chi^2 = 4.067$; $p = 0.131$	W = 0.047
Tenderness	3.4 ± 0.7	3.4 ± 0.7	3.8 ± 0.6	$\chi^2 = 3.748$; $p = 0.154$	W = 0.043
Overall acceptability	3.5 ± 0.6 [a]	3.5 ± 0.8 [a]	3.8 ± 0.5 [b]	$\chi^2 = 3.467$; $p = 0.177$	W = 0.040

Values are expressed as mean ± standard deviation
Superscripts (a, b) within a row indicate significant differences according to pairwise Wilcoxon tests with Bonferroni correction (p < 0.05)
Friedman's test assessed global differences among treatments; Kendall's W represents the degree of agreement among panelists

4. Discussion

The absence of significant differences in live weight, hot carcass weight, and cold carcass weight among guinea pigs fed alfalfa, chilca, or dill suggests that partial substitution of alfalfa did not compromise growth performance or carcass development. Similar results have been reported by Escobar et al. (2023), who found that replacing fresh alfalfa with hay or alternative forages did not affect weight gain or carcass yield. This indicates that when forages provide comparable nutrient density performance remains stable and it has been reported that native forages can maintain productive efficiency due to adequate protein and energy supply (Herrera et al. 2024; Bacca-Acosta et al. 2025). The carcass yield values observed in this study (70–71%) were within the range (68–75%) reported for intensively managed guinea pigs (Bermúdez et al. 2023; Goicochea et al. 2025). Although animals fed alfalfa showed slightly higher carcass yields, the differences were not statistically meaningful, confirming that both chilca and dill are suitable replacements at the tested inclusion levels. This aligns with the results of Zamora and Callacná (2017), who reported comparable carcass yields in guinea pigs fed diets containing non-conventional protein sources, reinforcing the nutritional adaptability of the species. Shrink loss during chilling was slightly lower in the chilca and dill groups, which could be attributed to the presence of natural antioxidant and bioactive compounds in these plants. Milenković et al. (2024) and Mujović et al. (2024) highlighted that dill essential oils contain phenolic and terpenoid compounds capable of stabilizing muscle membranes and reducing water loss during storage. Similarly, He et al. (2023) demonstrated that dietary inclusion of oregano oil improved meat oxidative stability and reduced drip loss in beef, suggesting that herbal bioactives may play a similar protective role in guinea pig meat. Physicochemical parameters such as pH, color, water-holding capacity, and cooking loss remained unaffected by the inclusion of chilca or dill. These findings are consistent with Muñoz Zambrano and Vargas Zambrano (2024), who reported normal pH ranges (5.8–5.9) and stable color in guinea pig meat across different feeding systems, indicating that post-mortem glycolysis proceeds normally regardless of forage source. Likewise, López (2025) found no significant effect of diet on the color or pH of carcasses evaluated at different post-mortem intervals.

The proximate composition parameters confirmed that moisture, protein, fat, and ash contents were not influenced by dietary treatment, aligning with Bermúdez et al. (2023) and Herrera et al. (2022), who found that protein and fat content in guinea pig meat remains stable when conventional protein sources are replaced by natural additives or alternative ingredients. The stability observed in the present study suggests that both chilca and dill provide a balanced nutrient profile that supports normal muscle deposition. The fatty acid profile revealed balanced proportions of saturated, monounsaturated, and polyunsaturated fatty acids, with a favorable n-6/n-3 ratio (~4.6–4.7). This lipid composition aligns with the observations of Guevara et al. (2016) and Herrera et al. (2022), who described similar PUFA proportions in guinea pigs fed diets enriched with omega-3 sources or alternative protein ingredients. The slight numerical increase in n-3 fatty acids in the dill-fed group may be related to the bioactive properties of its essential oils, which have been shown to enhance lipid metabolism and oxidative stability in meat products (Mujović et al. 2024; Milenković et al. 2024; Keller et al. 2021). From a sensory perspective, the equivalence of alfalfa and chilca across all attributes indicates that chilca does not negatively affect meat palatability, whereas dill resulted in higher flavor and acceptance scores. These differences could be linked to the presence of aromatic compounds in dill, such as anethole and carvone, known for their ability to enhance flavor perception (Mujović et al. 2024). Similar effects were described by Bermúdez et al. (2023), who found that herbal supplementation improved flavor and consumer acceptance of guinea pig meat.

5. Conclusions

Overall, the findings demonstrated that both chilca (*Baccharis latifolia*) and dill (*Anethum graveolens*) can replace alfalfa in guinea pig feeding without compromising carcass yield, physicochemical quality, or sensory attributes. Their use represents a sustainable strategy for smallholder production systems in the Andean region, promoting feed diversification, reducing feed cost and dependency on alfalfa, and supporting environmentally resilient livestock practices (Cardona 2020). Future studies should evaluate different inclusion levels, long-term effects on oxidative stability, and consumer perception to optimize their application under practical farming conditions.

Declarations

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