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## Final Weight and Meat Quality in Guinea Pigs with Different Levels of Oregano in the Feed

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### ABSTRACT

**Background:** Forage and feedstuff technologies with additives contributed to more efficient nutrition of herbivores. **Aim.** To evaluate the productive performance and organoleptic quality of guinea pig meat, fed with forage and balanced diets made with different levels of oregano. **Methods:** This paper consisted of two studies, one at El Romeral Farm, in Guachapala Canton, at the University of Cuenca, located at coordinates S 2°45'54", W 78°42'58" at an altitude of 2,254 meters above sea level; and another in the Molihers Feed Factory sheds, in Ochoa León, at coordinates S 2°49'48", W 78°59'12" at an altitude of 2,600 meters above sea level. The control (T1) diet consisted of Molihers-brand balanced feed for guinea pigs. The experimental treatments included: Treatment (T2) with phytogenics at a rate of 2 kg/ton; Treatment (T3) with phytogenics at a rate of 3 kg/ton; Treatment (T4) with phytogenics at a rate of 5 kg/ton. All four treatments contained 13.5% protein. A completely randomized experimental design was used, along with one-way ANOVA. The final weight was measured after 115 days. **Results:** No significant differences were found between the treatments for the final weights in the two trials. There were no differences in the organoleptic quality indexes, except for the color and crust for the Molihers in T3 and T4. **Conclusions:** It is possible to feed guinea pigs with alfalfa forage and balanced diets that include phytogenic additives such as oregano at doses of 3 and 4 kg per ton of feed, as similar weights to the control group are obtained, and the organoleptic indicators of the meat are not affected. This is due to the favorable effects of the organic compounds contained in the supplemented oregano.

**Keywords:** additives, organoleptic quality, diets, herbivores, production (*Source: AGROVOC*)

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## INTRODUCTION

Guinea pig farming has gradually gained a place within livestock activities, as its consumption has increased among the urban population in Ecuador and other Andean countries (Chela, 2015; Regalado & Usca, 2019; FAO, 2019). This growth has led many people to engage in its production as an alternative economic activity. This drives research aimed at improving guinea pig production, with one approach being nutrition-based enhancements, allowing producers to increase their economic returns. In this regard, the use of phytogenic additives in guinea pig feed requires further trials to measure its efficiency in diets that also include forages (Flores, 2018; Salinas *et al.*, 2020; Vargas *et al.*, 2022).

Accordingly, the aim of this study was to evaluate the productive performance of guinea pigs fed with forage and balanced diets formulated with different levels of oregano as a botanical additive.

## MATERIALS AND METHODS

### *Location of the experiments*

Two investigations were conducted in Azuay Province: one at the University of Cuenca farm, located in Guachapala Canton, known as El Romeral, at coordinates S 2°45'54", W 78°42'58" at 2,254 meters above sea level, and another at the Molihers balanced feed factory, located in Ochoa León, at coordinates S 2°49'48", W 78°59'12" at 2,600 meters above sea level.

### *Climatic characteristics of the research areas on Farms El Romeral and Ochoa Leon (Molihers Facility)*

At El Romeral Farm, the maximum temperature reached 22.21°C, with an average temperature of 16°C, and the minimum temperature was 11.5°C. The annual precipitation was 1,238 mm. In Ochoa León, the maximum temperature reached 14.67°C, with an average temperature of 11.42°C, while the minimum value was 11.5°C. The annual precipitation was 1,181 mm.

### *Bromatological analysis of the feeds used in guinea pigs*

Table 1 shows T1, the control treatment (Molihers), contains 10.03% protein in its formulation. The experimental treatments T2, T3, and T4 show a similar protein concentration, ensuring that all guinea pigs received equal nutritional intake.

### *Guinea pig feed formulas with 13.5% crude protein (CP), including chemical and phytogenic additives*

At El Romeral Farm, the balanced feed was prepared for use in field experimentation with guinea pigs, specifically for the different treatment groups.

### ***Experimental design to evaluate the feedstuffs in guinea pigs***

To evaluate the response of guinea pigs to being fed balanced feed with growth additives, 96 guinea pigs of approximately 30 days old, all of the same breed, were used. Their weight range and homogeneity were considered for the study. At 8 days upon receiving the animals (adaptation period), they were tagged on their ears one by one. The trials lasted 115 days, from July to October 2021, with 48 guinea pigs at El Romeral Farm and 48 guinea pigs at Molihers Farm. Ten days after the animals were introduced, they received a 0.5 ml dose of Cuy-Vac vaccine via subcutaneous injection. The initial weight was recorded using a precision scale, followed by biweekly measurements until the end of the experiment.

### ***Sensory evaluation***

The sensory evaluation was conducted to assess the acceptance of guinea pig meat, comparing animals fed with increasing doses of organic additives such as oregano to a control group receiving Molihers balanced feed. For this test, 17 panelists participated, completing an evaluation questionnaire that gathered their opinions on color, crust, flavor, texture, and aroma of the guinea pig meat. A fractional scale from 1 to 5 was used, where 1 represented the lowest value and 5 the highest for each characteristic assessed. A completely randomized design was applied, with four treatments and four replications, using 16 experimental units consisting of metal cages with a capacity of three guinea pigs each, and a total of 32 and 105 cages across both experiments. The diet consisted of 333.3 g of alfalfa per day and 33.3 g of balanced feed per guinea pig. Drinking water was provided *ad libitum*, with one drinker per experimental unit.

A Completely Randomized Design was applied, with four treatments and four replications, using 16 experimental units consisting of metal cages with a capacity of three guinea pigs each, and a total of 32 cages across both experiments. The diet consisted of 333.3 g of alfalfa per day and 33.3 g of balanced feed per guinea pig. Drinking water was provided *ad libitum*, with one drinker per experimental unit.

### ***Statistical method for the analysis of the results***

One-way analysis of variance (ANOVA): For each model, the normality assumptions were evaluated using the Shapiro-Wilks test ( $P < 0.05$ ), and the variance-covariance matrix was assessed using Mauchly's sphericity test. The Bonferroni test was used to control Type I error. The statistical software utilized for the analysis was SPSS® Version 25 (2018).

## **RESULTS AND DISCUSSION**

Growth promoters are products with varied biological actions, chemical characteristics, and different safety levels that are added to feed to optimize animal growth and enhance feed utilization. Their goal is to achieve better results, both productive and economic, similar to those reported by Vargas *et al.* (2022) and Coba (2012) reported that diets combining forages and mixed balanced feeds led to better final weight and higher meat quality in guinea pigs.

Plants like oregano are known to possess antidiarrheal, antioxidant, antiparasitic, and antimicrobial properties, which contribute to increased appetite, efficient feed conversion, improved digestibility, and the proper functioning of the immune system (Arcila, 2004; Flores *et al.*, 2018; Salinas *et al.*, 2020). Additionally, oregano promotes better productivity due to its bactericidal, bacteriostatic, antioxidant, and antimicrobial effects against various pathogenic microorganisms (Flores *et al.*, 2018).

Salinas *et al.* (2020); Ortiz *et al.* (2021) and Ricce (2021) indicate that the sustainability of an economic resource, such as the guinea pig, driven by the sale of its meat and surplus production, has evolved in recent years through the development of various models and strategies to enhance weight gain and growth efficiency in these animals. Furthermore, the use of phytogetic additives in mixed forage-balanced diets improves feeding efficiency and enhances meat quality, making guinea pigs more suitable for human consumption. Table 1 shows the results observed in El Romeral and Ochoa Leon. There were no significant differences between treatments regarding the final weight of the guinea pigs, which ranged from 1.13 to 1.18 kg at El Romeral and 1.18 to 1.30 kg at Ochoa León.

**Table 1. Initial and final weights (kg) of guinea pigs fed with balanced diets at different levels of oregano inclusion**

| PARAMETERS |                     | T1    |      | T2    |      | T3    |      | T4    |      |
|------------|---------------------|-------|------|-------|------|-------|------|-------|------|
|            |                     | X     | SE   | X     | SE   | X     | SE   | X     | SE   |
| El Romeral | Initial weight (kg) | 0.58a | 0.02 | 0.54a | 0.12 | 0.56a | 0.20 | 0.54a | 0.22 |
|            | Final weight kg.    | 1.13a | 0.26 | 1.14a | 0.24 | 1.18a | 0.37 | 1.16a | 0.31 |
| Molihers   | Initial weight (kg) | 0.58a | 0.22 | 0.55a | 0.19 | 0.57a | 0.26 | 0.54a | 0.22 |
|            | Final weight (kg)   | 1.30a | 0.49 | 1.22a | 0.16 | 1.18a | 0.36 | 1.22a | 0.26 |

Different scripts (a, b, c) within the rows indicate statistical significance between treatments ( $P < 0.05$ ) according to the Bonferroni test. T=control, T2= 2kg, T3= 3kg, T4= 5kg. Location; Romeral, Ochoa Leon At 115 days

Regarding the results from both trials, the effect of oregano proves to be important due to its properties, which enhance efficiency and feed consumption in animals. When this spice is incorporated into their diet, it leads to higher meat yield, extended natural preservation time, and reduced oxidation. These benefits have been observed in various studies that incorporated organic additives like oregano into guinea pig diets, combining forages and balanced feeds at different inclusion levels (Williams, 2014; Chela, 2015; Regalado & Usca, 2019; Sanchez *et al.*, 2021).

In this regard, Regalado & Usca (2019) conducted an experimental study on the inclusion of different oregano levels in balanced feed and concluded that the best treatment was with 20% oregano inclusion, showing significant differences ( $P < 0.05$ ) in the final weight of the animals. This treatment also led to an increase in meat quality and improved profitability. These authors recommend that producers implement natural growth promoters in their feed formulations to

enhance guinea pig development and achieve better carcass quality and cost-efficiency. Additionally, Chela (2015) found that when using different oregano inclusion levels during the growth and fattening stage, the highest final guinea pig weight was 1.32 kg when 1.5% oregano was incorporated into the diet.

In general, the most commonly used feeding system by guinea pig farmers is based on an exclusive forage diet, which can account for up to 70% of economic costs due to the rising prices of green fodder. This diet enhances the quality of fatty acids and proteins in the meat, but there is a potential for commercial growth by adopting more efficient diets for this species (Sanchez *et al.*, 2021; Huaman, 2021). Therefore, it is necessary to implement new feeding systems that allow for greater productive optimization, enabling the profitability of this business. These systems should incorporate cost-effective feeding techniques that also enhance meat quality (Bernal & Vázquez, 2020).

In these studies, weight gains similar to those in the control treatment with commercial bactericides are attributed to oregano, an aromatic plant containing thymol and carvacrol, which confer bactericidal properties and help maintain the necessary digestive microflora (Mayorga, 2016). Oregano also enhances food intake and nutrient digestion, acting as a pancreatic and intestinal activator, optimizing antioxidant enzymes such as superoxide dismutase and catalase, and improving intestinal microvilli (Chela, 2015; Mayorga, 2016; Valverde, 2021).

The lack of significant differences in weight gain is related to the fact that bactericides function as digestive efficiency enhancers, acting anabolically to promote rapid weight gain. In contrast, oregano, being a natural source, has a slower effect. This phenomenon was observed by Carbajal (2015) when applying the commercial product Zeramec, resulting guinea pigs exhibiting greater weight increase compared to oregano and other organic additives. The activity level of this system is closely tied to the type of diet the animals receive during rearing, with plant-based additives playing a role in digestive modulation (Mayorga, 2016; Valverde *et al.*, 2021). This effect was demonstrated in the study by Ramírez & Cárdenas (2022), who tested a combination of forage + phytogetic additives + balanced feed. In this system, forage provides bulk, vitamins, and minerals, and balanced feed supplies proteins and energy (Camino, 2014; Reynaga *et al.*, 2020).

The sensory evaluation (Table 2) presents the results of a panel assessment regarding color, crust, flavor, texture, and aroma. At El Romeral, no significant differences were found between treatments regarding color, crust, flavor, texture, and aroma indices. This outcome is attributed to the protective and preservative role of oregano's components, such as carvacrol, thymol, tannins, and essential oils, which provide antioxidant properties to the meat. These compounds help maintain the meat's freshness for a longer period while preserving optimal organoleptic properties.

In the Molierhs trial, significant differences were observed only in color and crust, with greater coloration in T4, while no differences were found among the remaining treatments. Additionally,

T3 and T4 showed less toughness compared to T1 and T2, suggesting that a higher oregano dosage reduced meat hardness.

**Table 2. Sensory evaluation of guinea pig meat in both experimental sites, conducted with 17 panelists.**

| PARAMETERS         | T1    |     | T2    |     | T3    |     | T4    |     |
|--------------------|-------|-----|-------|-----|-------|-----|-------|-----|
|                    | Mean  | SE  | Mean  | SE  | Mean  | SE  | Mean  | SE  |
| <sup>1</sup> Color | 3.78a | 1.3 | 3.78a | 1.2 | 4.56a | 0.7 | 3.89a | 0.8 |
| Crust              | 4.11a | 0.9 | 4.00a | 1.4 | 3.78a | 0.8 | 3.89a | 0.9 |
| Taste              | 4.67a | 1.0 | 4.11a | 0.8 | 4.33a | 0.9 | 4.56a | 0.5 |
| Texture            | 4.44a | 1.0 | 4.11a | 0.9 | 3.89a | 1.1 | 4.33a | 0.5 |
| Smell              | 3.33a | 0.7 | 4.11a | 1.1 | 3.89a | 1.1 | 4.00a | 1.1 |
| <sup>2</sup> Color | 3.88b | 0.6 | 2.88a | 1.0 | 3.00b | 0.9 | 4.13b | 0.4 |
| Crust              | 3.38b | 1.1 | 4.00b | 0.5 | 2.63a | 1.1 | 2.88a | 1.0 |
| Taste              | 4.25a | 0.7 | 4.13a | 0.6 | 3.85a | 1.0 | 4.63a | 0.7 |
| Texture            | 4.13a | 0.6 | 4.00a | 0.8 | 3.50a | 1.1 | 4.25a | 0.7 |
| Smell              | 3.75a | 0.9 | 3.50a | 1.1 | 3.38a | 1.1 | 3.88a | 0.8 |

**1: Romeral, 2: In Molierhs, different scripts (a, b) indicate significant differences (P < 0.05) between treatments.**

In the Molierhs trial, significant differences were observed in color and crust, with greater coloration in T4, while no differences were found among the other treatments. Additionally, T3 and T4 exhibited less toughness compared to T1 and T2, suggesting that a higher oregano dosage reduced meat hardness.

Various authors have supported these findings, evaluating the meat of guinea pigs and other herbivores that were fed forages and balanced diets. The balanced diets included classic ingredients as well as plant-based additives such as oregano, thyme, pepper, and rosemary (Marino, 2001; Arcilla *et al.*, 2004; Cano, 2016; Quiroga *et al.*, 2011; Carbajal, 2015; Chalán, 2015; FAO, 2019; Regalado & Usca, 2019; Bernaola *et al.*, 2021).

## CONCLUSIONS

Feeding guinea pigs with alfalfa forage and balanced diets containing phytogetic additives such as oregano at doses of 3 and 4 kg/t of feed is feasible. This approach results in weights similar to the control group and does not negatively impact meat organoleptic indicators. These benefits stem from the favorable effects of the organic compounds present in the supplemented oregano.

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## AUTHOR CONTRIBUTION STATEMENT

Research conception and design: FGB, FRAJ, RVGV, CSTI, GEGV, MPG; data analysis and interpretation: FGB, FRAJ, RVGV, CSTI, GEGV, MPG; redaction of the manuscript: FGB, FRAJ, RVGV, CSTI, GEGV, MPG.

## CONFLICT OF INTEREST STATEMENT

The authors state there are no conflicts of interest whatsoever.