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Hydroponic crops: a nutritional and sustainable alternative for the reproduction of guinea pigs (*Cavia porcellus*) in the coastal zone of Ecuador

Cultivos hidropônicos: uma alternativa nutricional e sustentável para a reprodução de porquinhos-da-índia (Cavia porcellus) na zona costeira do Equador

Cultivos hidropónicos: una alternativa nutricional y sostenible para la reproducción de cuyes (Cavia porcellus) en la zona costera de Ecuador

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Hydroponic forage, as part of the guinea pig diet, can significantly improve reproductive performance, offering a sustainable and economically viable feeding strategy for guinea pig production in small-scale farming systems. For decision-makers and/or agricultural managers in developing countries similar to Ecuador, this research can serve as a basis for making informed decisions.
Originality/value:
This study fills a gap in research by evaluating the reproductive effects of hydroponic forages, particularly corn-based, on guinea pigs. The findings contribute valuable insights for optimizing feeding strategies in small-scale animal production.

ABSTRACT

Introduction: This study, conducted under the Minor Species Production Program at the Technical University of Babahoyo, Ecuador, aimed to evaluate the effects of hydroponic forages based on corn (Zea mays) and rice (Oryza sativa) on the reproductive performance of improved guinea pigs (Cavia porcellus). **Methods:** A total of 45 guinea pigs (36 females and 12 males, 70 days old) were used, distributed across three treatments: T1 (Alfalfa + Concentrate + Water ad libitum), T2 (Hydroponic Corn Forage + Concentrate + Water ad libitum), and T3 (Hydroponic Rice Forage + Water ad libitum), with three replications and five experimental units per treatment. Reproductive performance was measured by pregnancy percentage, litter size, average litter weight at birth, average litter weight at weaning, mortality at first parturition, post-parturition estrus, and the cost-benefit indicator. Treatments were arranged in a Completely Randomized Design (CRD), and mean differences were evaluated using Tukey's test at a 5% significance level. **Results:** The best reproductive performance was observed in T2, with a pregnancy percentage of 100%, litter sizes of 4-6 offspring, an average litter weight at birth of 122.25 g, and an average litter weight at weaning exceeding 1000 g, indicating a weight gain of 295.52 g during the period. Additionally, T2 exhibited a cost-benefit ratio of 2.57, suggesting it is a sustainable and profitable feeding strategy. **Conclusion:** These results indicate that hydroponic corn forage significantly enhances reproductive performance in guinea pigs compared to traditional alfalfa and rice-based forages, supporting its use for sustainable and economically viable guinea pig production.

Keywords: Cavia porcellus; reproductive performance; hydroponic forage; Zea mays; Oryza sativa sustainable agriculture.

RESUMO

Este estudo foi desenvolvido no Programa de Produção de Espécies Menores da Universidade Técnica de Babahoyo – Equador, onde foi avaliado o efeito de Forragens Hidropônicas à base de Milho (Zea mays) e Arroz (Oryza sativa) nos Índices Reprodutivos de cobaias melhoradas (. Cavia porcellus) durante 14 semanas, foram utilizados 45 animais, 36 fêmeas e 12 machos, com 70 dias de idade em fase reprodutiva, distribuídos em três tratamentos T1 (Alfafa + Concentrado + Água ad libitun) T2 (Forragens Hidropônicas à base de Milho (Zea mays) + Concentrado + Água ad libitum) e T3 (Forragem Hidropônica à base de Arroz (Oryza sativa) + Água ad libitum) (com três repetições e 5 unidades experimentais cada; O comportamento reprodutivo foi avaliado estabelecendo como variáveis: Porcentagem de prenhez, Tamanho da ninhada , Peso médio da ninhada ao nascer, Peso médio da ninhada ao desmame e Mortalidade ao primeiro parto por tratamento, Calor pós-parto e Indicador Custo Benefício, os tratamentos foram distribuídos em Delineamento Completamente Randomizado (DCA). Para avaliação das médias foi utilizado o teste de Tukey com nível de significância de 5%. Em T2 os melhores resultados foram alcançados para as variáveis percentual de gravidez 100%; Tamanho da ninhada 4 – 6 filhotes por ninhada; O peso médio da ninhada ao nascer foi de 122,25 g, indicador favorável; peso médio da ninhada ao desmame superior a 1000 gramas o que demonstra um ganho de peso neste período de 295,52 g e um Benefício/Custo de 2,57 resultando numa dieta sustentável e rentável neste período.

Palavras-chave: Cavia porcellus; desempenho reprodutivo; forragem hidropônica; Zea mays; Oryza sativa; agricultura sustentável.

RESUMEN

Este estudio se desarrolló en el Programa de Producción de Especies Menores de la Universidad Técnica de Babahoyo – Ecuador, donde se evaluó el efecto de Forrajes Hidropónicos a base de Maíz (*Zea mays*) y Arroz (*Oryza sativa*) sobre los Índices Reproductivos de cuyes mejorados (*Cavia porcellus*) durante 14 semanas, se utilizó 45 animales 36 hembras y 12 machos de 70 días de edad en etapa reproductiva, distribuidos en tres tratamientos T1(Alfalfa + Concentrado + Agua ad libitun) T2 (Forrajes Hidropónicos a base de Maíz *(Zea mays)* + Concentrado + Agua ad libitum) y T3 (Forraje Hidropónico a base de Arroz *(Oryza sativa)* + Agua ad libitum) (con tres repeticiones y 5 unidades experimentales cada uno; se evaluó el Comportamiento Reproductivo estableciendo como variables; Porcentaje de preñez, Tamaño de la camada, Peso promedio de camada al nacimiento, Peso promedio de la camada al Destete y Mortalidad al primer parto por tratamiento, Celo post parto y el Indicador Beneficio Costo, los tratamientos fueron distribuidos bajo un Diseño Completamente al Azar (DCA). Para la evaluación de medias se utilizó la prueba de Tukey al 5 % de significancia. En el T2 se lograron los mejores resultados para las variables porcentaje de preñez 100 % ; Tamaño de camada 4 – 6 crías por camada ; Peso promedio de la camada al nacimiento fue de 122,25 g un indicador favorable ; peso promedio de la camada al destete superior a los 1000 gramos lo cual muestra una ganancia de peso que fue de 295,52 g en este periodo de tiempo y un Beneficio/Costo de 2,57 dando como resultado una dieta sostenible y rentable en este tipo de producciones.

Palabras clave: Cavia porcellus; rendimiento reproductivo; forraje hidropónico; Zea mays; Oryza sativa agricultura sostenible.

INTRODUCTION

Guinea pig production has been growing at an accelerated pace, especially in rural areas of the Ecuadorian Sierra, which sees this production as a source of economic income, which is why it is important to look for feeding alternatives that allow achieving better responses in relation to the reproductive parameters of the species (Alcívar et al., 2022).

The distribution of the guinea pig population is very wide, due to its reproductive capacity, its short life cycle and its easy adaptability to diverse climatic conditions ranging from 0 m.a.s.l. to altitudes of 4,500 m.a.s.l., both in cold and warm areas, being a species widely exploited in the rural population of the highlands (Toapanta, 2018).

The guinea pig (cuy, curiel, kuri, etc.) are rodent mammals that live in Andean areas in Bolivia, Ecuador, Peru and Colombia; their population reaches around 35 million animals. They have a high capacity to adapt to the most diverse climatic conditions; they can be found in coastal areas, in plains territories and at altitudes of up to 4500 meters above sea level, where temperatures can vary either being warm or cold depending on the location (Usca, 2022).

According to Navarro (2022) guinea pigs are destined for family consumption due to their high protein content. But in a broader sense, we could define poultry or guinea pig farming as the branch of animal sciences dedicated to the management, general guinea pig breeding guidelines, ageing, nutrition, feeding, genetic improvement, reproduction, consumption and commercialization of guinea pig meat.

According to Riego (2021) today it is one of the most cultivated species by farmers, which makes its consumption something traditional. It is also worth mentioning that one of the uses is the production system, which are more common in the highlands (Cárdenas Villanueva, et al., 2018) describes Cavia porcellus as a common species in our Andes, which has good nutrition and has its own flavor and nutritional value that make it an ideal source of protein and lower fat content.

An overview of the literature: reproductive performance and general health in guinea pigs

Guinea pigs (Cavia porcellus) have been the subject of various studies aimed at understanding the impact of diet and environmental factors on their reproductive performance and overall health. The nutritional quality of the diet during early development significantly affects the body weight and reproductive maturation of guinea pigs;

For instance, Bauer et al. (2009) found that a high-protein diet during gestation and lactation accelerates growth and reproductive onset, particularly in females . Additionally, prenatal stress has been shown to influence growth and reproductive parameters, with stressed females exhibiting faster growth and earlier maturity compared to controls (Schöpper et al., 2012) .

Reproductive traits in guinea pigs are influenced by multiple factors, including maternal age and seasonal variations. Czarnecki and Adamski (2016) highlighted that litter size and birthweight are significantly affected by the mother's age and the season of birth, with larger litters generally correlating with lower birthweights.

Moreover, the lunar cycle has been reported to affect reproductive and productive traits in guinea pigs, such as litter size and mortality rates, indicating a complex interaction between environmental factors and reproductive success (Perea et al., 2024). Nemeth et al. (2021) investigated the modulation of cortisol concentrations and social dominance in adolescent male guinea pigs in response to dietary fatty acids, highlighting the intricate relationship between nutrition, stress physiology, and social behavior. Furthermore, Levy et al. (2023) provided valuable insights into the comparison of point-of-care lactate instruments in guinea pigs, contributing to the refinement of diagnostic methods in veterinary medicine. Additionally, Nemeth et al. (2023) examined metabolic rates in female guinea pigs during different reproductive stages, offering crucial information on the physiological changes associated with reproduction in this species.

Nutritional interventions have also been explored for their impact on reproductive health and meat quality. The inclusion of Euphorbia heterophylla in the diet improved the nutritional quality of guinea pig meat by increasing n-3 polyunsaturated fatty acids, which are beneficial for health (Grongnet et al., 2013). Similarly, the antioxidant properties of cultured wild ginseng root extracts have shown positive effects on male reproductive functions by reducing oxidative stress and enhancing sperm motility and testosterone levels (Yun et al., 2016).

Water intake is another critical aspect influencing guinea pig health. Wolf et al. (2020) demonstrated that water consumption varies significantly among small mammals and is influenced by factors such as ambient temperature and food composition. Adequate water supply is essential to prevent health issues like urolithiasis and ensure proper nutrient intake.

Litter size is highly dependent on management methods and genetic quality. Much depends, among other things, on the number of mature follicles, implantation of fertilized eggs, and fetal survival and resorption rates. All this is due to genetic and environmental factors such as diet, health and climatic conditions, which significantly affect fertility (Rojas, 2020).

The size of the pregnant guinea pig is more influenced by the environment in which the breeders find themselves during the reproductive phase, as well as by the number of eggs released and the fertile capacity of the spermatozoa. Thus, there are no defined or established breeds, so there is great variability in the litter, on the other hand, the nutritional factor plays an important role in the conception, attachment and development of the fetus. It was also demonstrated that the litters born most frequently are 2-3 litters per mother; the most common category is 1 to 5 offspring per birth (Navarro, 2022).

Arteaga (2019) states that litter size in guinea pigs can vary, but generally ranges from 2 to 8 offspring per litter. Factors such as the age of the female, nutrition, genetics and environmental conditions can influence the number of offspring. Proper management, including a balanced diet and an environment conducive to reproduction, contributes to a healthier litter size. It is also important to consider the frequency of reproduction, as guinea pigs are able to reproduce throughout most of the year due to their frequent estrous cycle.

Guinea pigs have a good responsiveness when they are provided with adequate feeding can be obtained significant weight gain and increased efficiency in the use of high-level energy. Also, it mentions that as the energy level of the diet increases, the conversion efficiency also increases and the quality of nutrition is improving (Muñoz, 2019).

Lopez et al. (2020) also mentions the excessive accumulation of energy in the guinea pigs' organism is converted into fat due to the ingestion of carbohydrates. Most plants contain 75 % in their composition.

The guinea pig is a herbivore and feeds mainly on green fodder. If you have several different types of food, always keep in mind its preference for green forage. This type of diet uses forage as the only source of food, so it depends on its availability, which is highly influenced by seasonalities in forage production. Forage is the main source of nutrients and guarantees an adequate intake of vitamin C (Peru, 2018).

Hydroponic green forage (HGF) is an innovative system of animal feed production, which involves the cultivation of germinated seeds in an inert substrate, using nutrient solutions in a controlled environment. Unlike traditional forage, which is grown in soil, HGF is developed in trays or containers in which water and nutrients are optimally supplied for plant growth (Chauca, 2020).

The use of hydroponic forages based on corn and rice can offer significant nutritional value for guinea pig production. Hydroponic corn is a rich source of carbohydrates, providing essential energy for guinea pig growth and metabolic activity. It also contains protein, although it is important to supplement with additional protein sources (Cardenas et al., 2018).

An amount of concentrate of 20 grams per day is recommended for breeding guinea pigs, which should be 10% of their feed in adult guinea pigs, the daily intake of forage should be 85% and the concentrate will go to 15% because it is now considered an extra, giving them only one ration per day, usually in the morning. If it weighs up to 500 grams, it needs 45 grams of concentrate per day. If its weight exceeds 500 grams, it will need 60 grams of concentrate per day. (Gallego, 2016).

Hydroponic rice forage can provide carbohydrates, fiber and some protein. However, it is critical to balance the diet, as rice may lack certain essential amino acids. Supplementing with other protein sources and nutrients will ensure a complete and balanced diet for guinea pigs (Hafez, 2020).

Successful implementation of green hydroponic forages in guinea pig feeding requires proper management of hydroponic systems and selection of appropriate plants (Tello, 2022).

MATERIALS AND METHODS

This research was carried out in the Minor Species Program of the Veterinary Medicine Faculty of Agricultural Sciences of the Technical University of Babahoyo,, Ecuador. All procedures involving animals in this study were conducted in accordance with the ethical standards of the university. Attention was taken to ensure that the guinea pigs were housed in a suitable environment with appropriate ventilation, temperature, and humidity controls. The animals were provided with adequate food and water, and all efforts were made to minimize suffering. Handling and experimental procedures were performed by trained personnel to ensure animal welfare, adhering to the principles of the 3Rs (Replacement, Reduction, and Refinement). The study was designed to use the minimum number of animals necessary to achieve scientific validity while ensuring the reliability of the results.

The research is aimed at feeding hydroponic fodder based on corn (*Zea mays*) and rice *(Oryza sativa) for the* feeding of improved guinea pigs *(Cavia porcellus)*, within the minor species program, which has a population of 160 animals, including breeding, rearing, fattening and reproductive animals, both males and females.

For the development of the research, 45 experimental units were used, 36 females and 9 males, 60 days old, which were selected as future breeders within the program. Nutritional based on hydroponic crops based on rice and corn were used against a control treatment which is alfalfa, the treatments will be applied to the experimental units in the reproduction phase (60 days of age of the guinea pigs) which were evaluated for 14 weeks.

Table 1. *Treatments studied*

Treatment	Composition
T0	Alfalfa + Concentrate + Water as desired
T1	Hydroponic fodder based on Corn (*Zea mays)* + Concentrate + Water at will.
T2	Hydroponic fodder based on Rice (*Oryza sativa*) + Concentrate + Water at will.

Note. Own elaboration with the research data (2024)

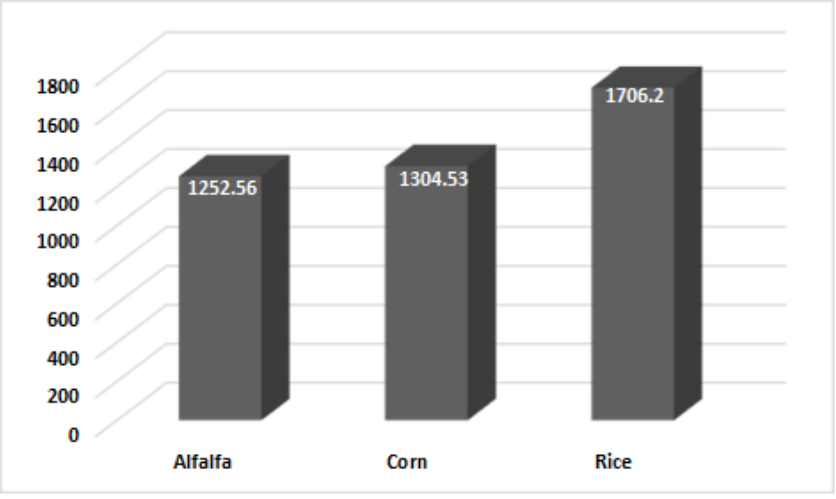
The effect of the use of hydroponic forages based on corn (*Zea mays*) and rice (*Oryza sativa*) in the tropics as a food source for guinea pigs in the reproductive stage was evaluated. For this purpose, two treatments were established with three replications versus a control treatment, giving 9 experimental units with 5 animals (4 females and 1 male) per experimental unit with a total of 45 animals per experimental unit. The experimental units were distributed under a Completely Randomized Design (CRD) and the experimental results obtained were subjected to the Comparison of Means according to Tukey at the significance levels of $P < = 0.05$ and $P < = 0.01$.

The present investigation was based on the analysis of the processing of data taken during 14 weeks of study where data related to reproduction, breeding and management were evaluated, compiled, registered and used. The variables evaluated were pregnancy percentage, litter size, average litter weight at birth, average litter weight at weaning, average litter weight at weaning, litter weight gain and mortality at first birth by treatment, concentrate, forage and total feed consumption, feed conversion and cost benefit. This provided valuable information to optimize reproduction and breeding practices, improve efficiency and guarantee the welfare of the guinea pigs.

RESULTS AND DISCUSSION

The results of the first variable studied (Figure 1), initial weight at mating, did not show highly significant differences, the best response was obtained with T2 (1706.2 g) followed by T1 (1304.53 g) and finally T0 (1252.56 g).

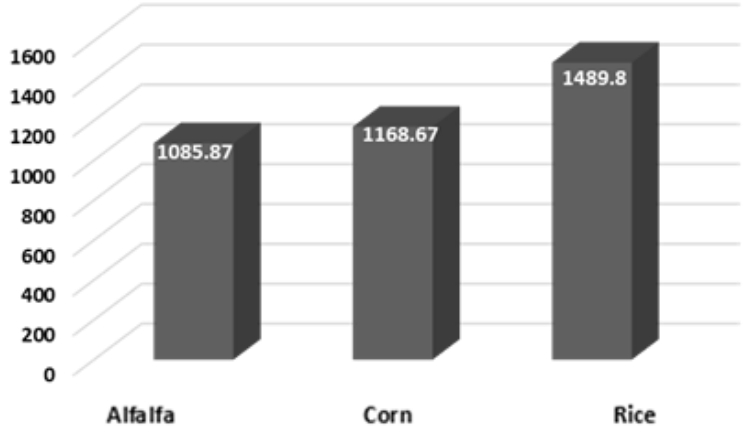
Figure 1. Initial weight at pairing



Note. Own elaboration with the research data (2024)

The results of the final weight (Figure 2) after delivery showed highly significant differences $p > 0.01$, T2 recorded the highest weight (1489.8g) followed by T1 with (1168.67g) and finally T0 with (1085.87g).

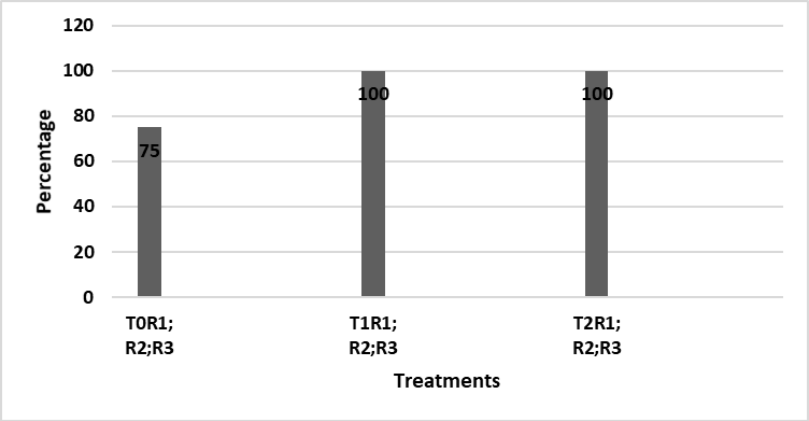
Figure 2. Final weight after delivery



Note. Own elaboration with the research data (2024)

When analyzing the percentage of pregnancy, the best results were obtained with T1 and T2 with 100% pregnancy, followed by T0 with 75% (Figure 3).

Figure 3. Average percentage of pregnancy.



Note. Own elaboration with the research data (2024)

In relation to litter size in the treatments, there were highly significant differences among the study treatments at (P >0.05) it was possible to establish that the largest litter sizes were in the T0 rice treatment with an average of 4.75/U, that is, 4-5 offspring per calving (Table 2).

Table 2. Litter size at birth

LITTER SIZE BIRTH				
TREATMENT	**1**	**2**	**3**	**4**
T0R1	1	1	1	0
T0R2	0	3	2	2
T0R3	2	0	2	3
T1R1	3	2	3	2
T1R2	1	2	3	2
T1R3	3	2	2	1
T2R1	6	4	9	3
T2R2	4	3	5	3
T2R3	4	3	8	4

Note. Own elaboration with the research data (2024)

The result for litter size at weaning showed that with T2 there was less mortality, having an average of the original litter size (Table 3).

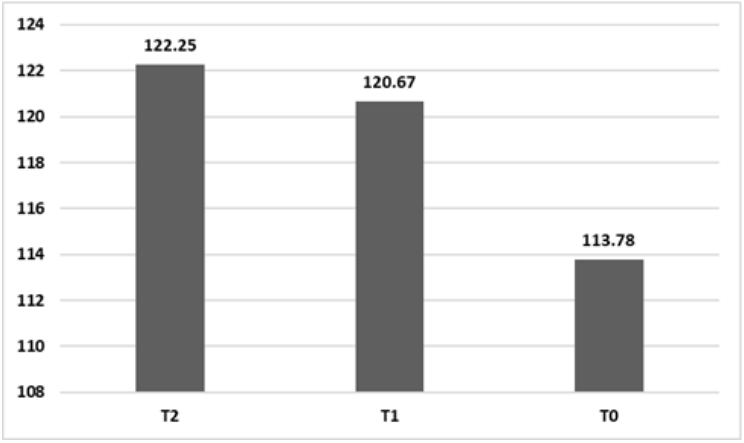
Table 3. Weaning litter size

LITTER SIZE WEANING				
TREATMENT	**1**	**2**	**3**	**4**
T0R1	1	1	0	0
TOR2	0	3	2	2
T0R3	2	0	2	3
T1R1	2	2	3	2
T1R2	1	2	3	2
T1R3	3	2	2	1
T2R1	6	4	6	3
T2R2	4	3	5	3
T2R3	4	3	8	4

Note. Own elaboration with the research data (2024)

The average litter weight at birth did not show significant differences at (P>0.05) with a coefficient of variation of 3.40, the best results were obtained with T2 with values of 122.25 g; followed by T1 with 120.67 g and the lowest response was recorded with T0 with an average weight of 113.78 g, as shown in Figure 4.

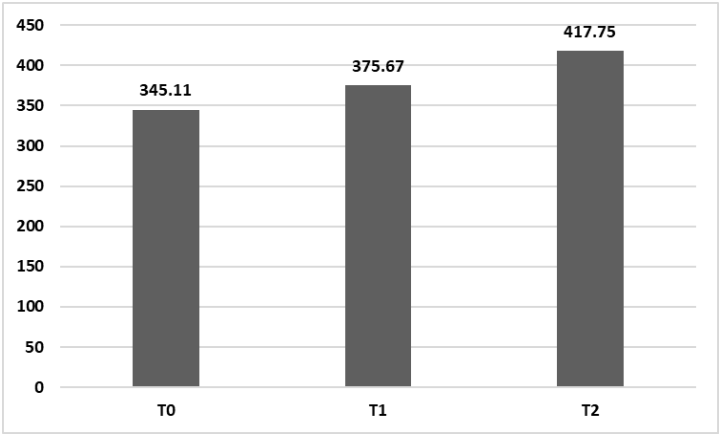
Figure 4. Birth weight (g)



Note. Own elaboration with the research data (2024)

In the average litter weight at weaning, significant differences were obtained (P>0.05) with a coefficient of variation of 3.03, the best response was obtained with T2 (417.75 g), followed by T1 (375.67 g) and finally T0 (345.11 g) average weight in each treatment. (Figure 5)

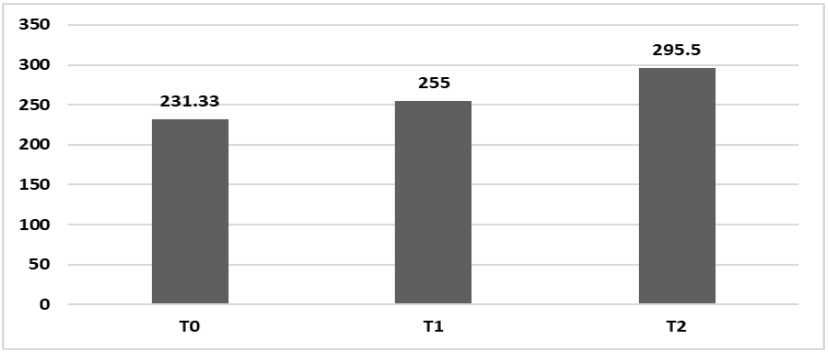
Figure 5. Average weaning weights (g)



Note. Own elaboration with the research data (2024)

In relation to live weight gain, significant differences existed (P>0.05) with a coefficient of variation of 5.15, T2 recorded the highest weight gains in all replicates with an average value of 295.5 g, followed by T2 with 255 g and finally T0 with 231.33 g, as shown in Figure 6.

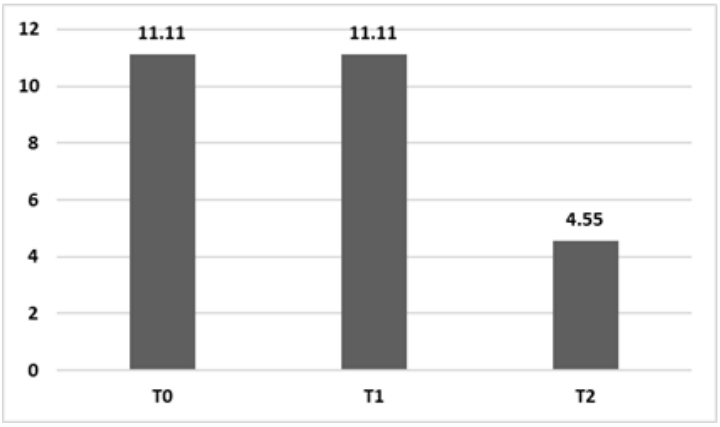
Figure 6. Live weight gain (g)



Note. Own elaboration with the research data (2024)

The highest percentages of mortality in the present study shared value between T0 and T1 with 11.11 %, while with T2 mortality was lower with 4.55 % with no significant differences found at (P>0.05) with a coefficient of variation of 0.25 (Figure 7).

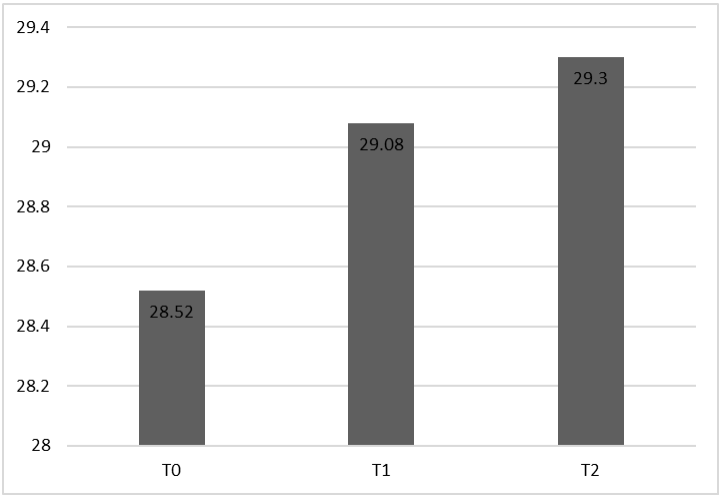
Figure 7. Mortality



Note. Own elaboration with the research data (2024)

When analyzing feed consumption, it was identified that there were no significant differences (P >0.05) between treatments, with a mean consumption of feed and/or concentrate of g for T0 (28.52 g) followed by T2 (29.08 g) and finally for T1 (29.30 g), as shown in Figure 8.

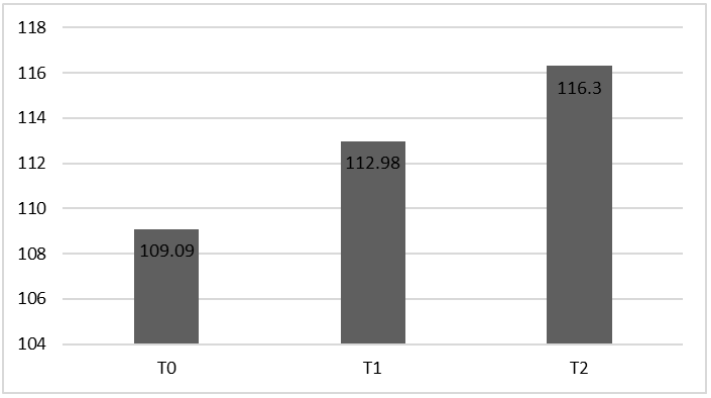
Figure 8. Average Concentrate Consumption (g)



Note. Own elaboration with the research data (2024)

The results obtained with respect to hydroponic forage consumption also established that there are no significant differences (P>0.05), with a coefficient of variation of 3.72; where the best responses were achieved by supplying T0 with 109.08 g, followed by T1 with 112.98 g and T2 with 116.3 g on average per treatment considering all replicates (Figure 9).

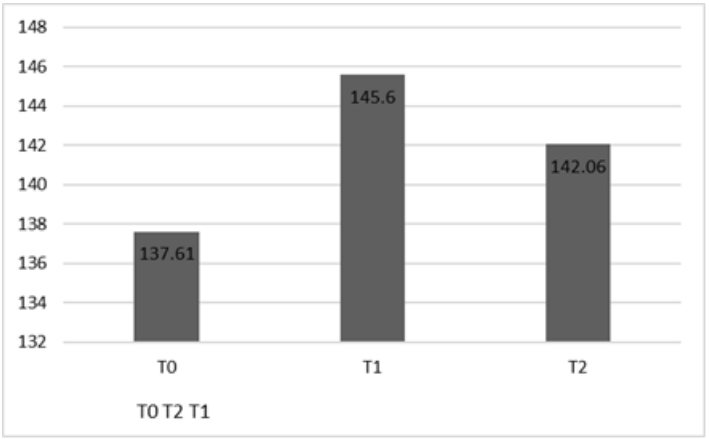
Figure 9. Average forage intake (g)



Note. Own elaboration with the research data (2024)

When evaluating the total feed intake, it was reported that there were no significant differences (P>0.05), with a coefficient of variation of 3.15, it was identified that the best response was established with T0: 137.61 g; followed by T2: 145.60 g and lastly with T1 with 142.06 g. On average for the treatments and their replicates, Figure 10.

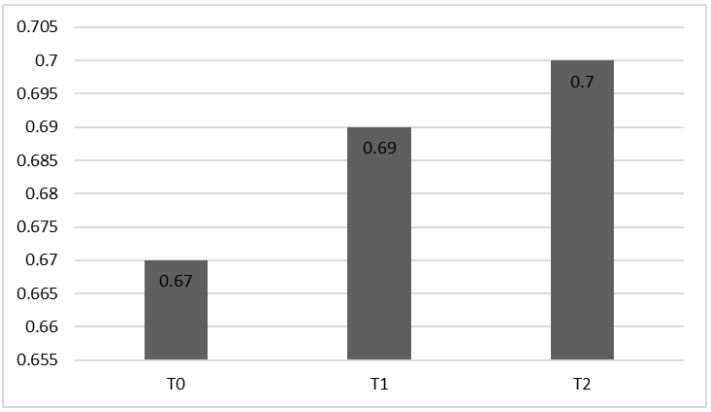
Figure 10. Average total consumption (g)



Note. Own elaboration with the research data (2024)

Regarding feed conversion, the best response was recorded with T0:0.67; with an increase in T2: 0.69 and T3: 0.70, on average for the treatment-repeat ratio (Figure 11).

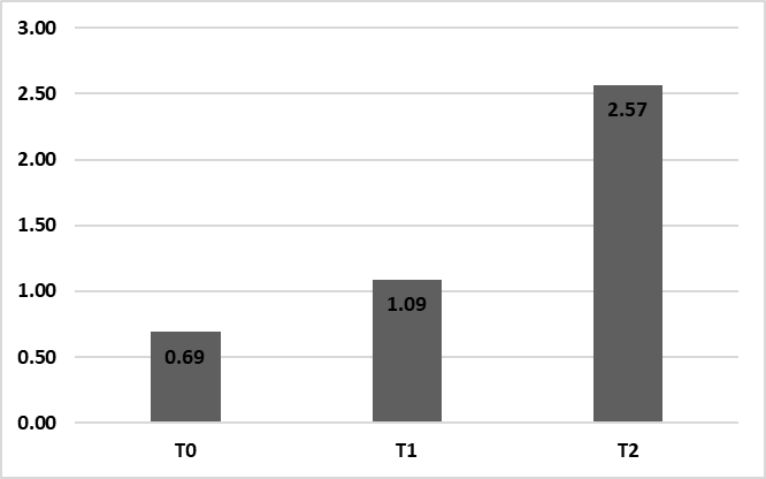
Figure 11. Feed conversion



Note. Own elaboration with the research data (2024)

The best results for the Cost-benefit Ratio were obtained in T2 with 2.75, followed by T1 with 1.09 and T0 with 0.69. This data allows us to mention that raising guinea pigs in the coastal region using hydroponic fodder is profitable for the producer, which makes it an animal production (Figure 12).

Figure 12. Cost-Benefit results



Note. Own elaboration with the research data (2024)

The reproductive parameters obtained when using hydroponic forages were positive in most of the variables evaluated, this may be due to the fact that the guinea pig, being considered a monogastric herbivorous species, adapts very easily to the consumption of cold and tropical climate forages, allows the producer to establish varied feeding systems ,in the first variable weight at mating the best weight was 1706.2 g ,compared to the weights of 1040.00 g which was the weight recorded by (Lopez 2018) and the weights of (Salinas 2015) which were 1111.11 g which were similar to those of (Atau 2020) which had a result of 1212.44 g ; in the second variable of weight after calving we found weight of 1270.00 g by (Lopez 2018) in addition to these weights we found results of 1489.8 that do not have much statistical difference in this own result ; within the variable litter size at birth we obtained the values of 4.75/U average , similar to the results of (Salinas 2015) with 3.19/U in his work, we can also see that in the results of (Atau 2020) could be evidenced 2.8/U , very similar result to that found in the research of (Lopez 2018) 2.5/U; following with the variable pregnancy percentage , the best result was 100 % of pregnancy , similar to the results of (Lopez 2018) with 100 % also, followed by the results of (Salinas 2015) with 81 % of pregnancy being superior to those recorded by (Atau 2020) with 73 % of pregnancy; following with the weaning weight variable the results we obtained were 122.25 g on average , result lower than those found by (Salinas 2015) which were 366.25 g , but were higher than the results of (Lopez 2018) with 175 g and (Atau 2020) with 108 g being much lower than the other results compared ;following with weaning weight the results obtained were weights of 417.75g , higher than those found by (Lopez 2018) with 348.75 g , but being lower than the results obtained by (Salinas 2015) with 1004.75 g and (Atau 2020) with 835.71 g obtained respectively.

Regarding to the daily live weight gain, results of 19.66 g of daily weight gain result lower than those obtained by (Salinas 2018) which was 32.20g daily; with the last variable which is mortality we can say that the result obtained which was 11.11 % , being higher than those obtained by (Salinas 2015) with 9.4 % and (Lopez 2018) with 6.77 % respectively.

In the context of reproductive performance, the present study evaluated the effects of hydroponic forages based on corn (Zea mays) and rice (Oryza sativa) on improved guinea pigs. The results indicated that the diet including hydroponic forage based on corn (T2) led to better reproductive outcomes compared to traditional alfalfa-based diets. These findings align with previous research suggesting that high-quality, protein-rich diets positively impact reproductive health and growth in guinea pigs (Bauer et al., 2009; Schöpper et al., 2012) .

Our results also complement Czarnecki and Adamski's (2016) observations on the effects of maternal age and seasonal variations, suggesting that diet quality can mitigate some of these factors. The improved reproductive outcomes with hydroponic corn forage could also be attributed to its superior nutrient profile, which is consistent with findings by Grongnet et al. (2013) on the benefits of diet modifications for enhancing meat quality and reproductive health. Additionally, our study aligns with Yun et al. (2016), who highlighted the role of antioxidants in reproductive health, indicating that the nutrient-rich hydroponic forages might also offer protective antioxidant benefits. Collectively, our findings contribute to understand how innovative dietary interventions can improve reproductive efficiency in guinea pigs, supporting sustainable animal production practices.

FINAL REMARKS

The best reproductive parameters such as pregnancy percentage, litter size, average litter weight at birth, average litter weight at weaning, average litter weight and mortality at first parturition per treatment were obtained with T2, which consisted of hydroponic forage based on rice (*Orza sativa*) + Concentrate + water at will, giving as a conclusion that it is the best option as a diet in the tropics.

In terms of total feed intake, the best response was established with T2 with 144.6 g, which indicates that the animals have a higher intake and reception of T2 rice. In relation to the cost-benefit indicator, (T2) was the one that registered the best response from an economic point of view, that's imply efficient diet and at the same time profitable when used in production.

Limitations of the study and future research

Although our results indicate significant benefits from hydroponic forage, the underlying biochemical and physiological processes remain unclear. Previous studies have highlighted the sensitivity of growth and reproductive maturation to dietary quality (Bauer et al., 2009) and environmental factors such as prenatal stress (Schöpper et al., 2012). Methodologically, the relatively small sample size of 45 animals limits the generalizability of the findings, and the 14-week duration may be insufficient to capture long-term reproductive trends and delayed effects of dietary interventions. While a Completely Randomized Design (CRD) and Tukey's test were employed for mean comparisons, more sophisticated statistical models could provide deeper insights into the data.

Future research should focus on longitudinal studies to observe the prolonged effects of hydroponic forage diets on reproductive performance and overall health of guinea pigs, helping to understand any cumulative or delayed impacts of dietary changes. Additionally, it is essential to investigate potential interactions between diet and other environmental or genetic factors that could influence reproductive outcomes, as highlighted by studies on the impact of prenatal stress and nutritional quality (Schöpper et al., 2012; Bauer et al., 2009). Exploring these areas could enhance our understanding of the complexities involved in optimizing guinea pig production systems.

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B. data research and statistical analysis:	25%	25%	25%	25%
C. elaboration of figures and tables:	25%	25%	25%	25%
D. drafting, reviewing and writing of the text:	25%	25%	25%	25%
E. selection of bibliographical references	25%	25%	25%	25%
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