Effect of the combination of cassava silage with alcohol distillery vinasse on the productive indicators of pre-fattening pigs

Asterio DenisBarbaru1, Ana Ximena Salguero-Cajo2, Carlos Roberto Lopez-Paredes3, Fabian Miguel Carrillo-Riofrio4, Karel Ismar Acosta-Perez5

1Escuela Superior Politécnica de Chimborazo (ESPOCH) Sede Orellana, Ecuador. https://orcid.org/0000-0002-2862-4558
2Escuela Superior Politécnica de Chimborazo (ESPOCH) Sede Orellana, Ecuador. https://orcid.org/0000-0001-8790-160X
3Escuela Superior Politécnica de Chimborazo (ESPOCH) Sede Orellana, Ecuador. https://orcid.org/0000-0002-7455-0721
4Escuela Superior Politécnica de Chimborazo (ESPOCH) Sede Orellana, Ecuador. https://orcid.org/0000-0003-2744-267X
5Universidad de Las Tunas. Centro de Estudios de Desarrollo Agrario Las Tunas (CEDAT). Cuba. https://orcid.org/0000-0003-1599-1030

ABSTRACT

Different investigations have been carried out to fatten pigs, the objective is to test the effect of cassava silage combined with vinasse from an alcohol distillery in the feeding of pre-fattening animals. It was used as a quantitative and qualitative methodology and experimentation was used as a technique, this was developed in an experimental farm during an evaluation period of 42 days, an Anova was used to verify the presence of significant differences and then to compare the means a test of Duncan. The results were positive due to the increase in the body mass of the animal, which suggests that the combination of the product in pigs precedes having a positive effect on feeding and higher productive performance, recommending the use of the product as a food alternative for the pig industry.

Keywords: pig feeding, body weight, cassava, stillage, pig, productive.

1 Introduction

The expansion of the production of monogastric animals in tropical countries has rested on massive imports of the main ingredients that make up concentrated feed, such as cereals and soybeans. This is due, in part, to their low agricultural yields (30-40% of what they reach in temperate climates). In these imports, prices fluctuate according to agreements, treaties, subsidies and tariffs, among others, which in turn depend on political, social and even climatic situations that influence crop yields and, of course, availability. All of the above is reflected in the high cost of raw materials used in pig production which, together with low purchasing power, causes a deficit in the consumption of animal protein by the population (FAO, 2022).

Within the group of monogastric animals, the pig presents a series of peculiarities that makes it a key element within the gear of any integrated production system. Part of these advantages derive from its ability to easily adapt to different management and feeding schemes, with the characteristic of being, in certain cases, the perfect recycler within a livestock or livestock-agricultural system. In addition, the waste generated in its production (manure and wastewater) are valuable sources for the generation of other usable resources within the same system, since they provide energy, as is the case of biogas, and organic fertilization with the use of effluents (Chamba, et.al, 2020).

Pig feeding represents about 70% of the expenses that occur in the intensive exploitation of this species, in addition, its marked influence on the reproductive results and the performance of the animals, makes it an element of extraordinary importance within of this production (Hoyos and Hernández, 2019).

Pork meat is one of the main sources of protein for human consumption. For pre-fattening pigs, a key category within these production systems, it is necessary to take into consideration that in the first weeks after weaning there are losses of 10-25%, mainly due to gastrointestinal disorders, which affects the productive behavior of the species, for what is necessary a continuous evaluation of the diet. (Gonzales-Rios, you at ibn, 2021).
Cassava silage combined with stillage stillage may be a viable option in swine feeding, but it is important to consider several factors before making a full assessment. (Herrera, Rodríguez and Arango, 2020).

First, cassava is a source of carbohydrates and fiber that can be used as an ingredient in pig diets, but it also contains anti-nutritional compounds, such as hydrocyanic acid, which can be toxic if not handled properly. (Silva, & Costa 2018). It is important to ensure that the cassava silage is properly fermented to reduce the levels of anti-nutritional compounds and guarantee the safety of the pigs (López, Rabelo and Nascimento, 2021).

Due to all the above, which explains the need to find less expensive feed and, at the same time, solutions to enteric problems, the implementation of the use of ethanol distillery residues and cassava silage in pig feeding is advocated as a way of sustainability of this productive system.

2 Materials and methods

The present investigation was carried out in an experimental farm with a duration of 42 days. Ninety commercial Landrace x Yorkshire pigs (castrated males) with an initial weight of 6 ± 2 kg housed in 8 pens were used. Experimental treatments with 3 repetitions each were evaluated, for which each boxer constituted an experimental unit, and they had 10 animals each. A randomized block design was applied. The treatments consisted of a control group where the untreated animals consumed feed B established in the conventional diet adjusted to the standards according to Souza, Leal and Oliveira (2019), for this category under study and two groups of animals treated with cassava silage at a rate of 3 liters per animal, plus the vinasse that was included at a level of 2.0 % 2.5% according to the dry matter of the food consumed (feed B). According to the methodology described by (Amador-Reyes et al., 2021).

The food supply was carried out in linear feeders (40 cm of feeder front per hole) in the experimental stage and 2 times a day. Water was supplied at will, in nipple drinkers, at a rate of two nipples per cubicle and permanently. The traditional diet was supplied according to the requirements established for this category (Castillo, et. al., 2018).

The stillage to develop this work was collected from the Delicia Distillery, Puerto Padre Municipality, Las Tunas province. It was stored in cisterns with a capacity of 5000 L. The quality characterization of this was carried out according to the methodology proposed by Alves, et al. (2019).

For the preparation of the silage, a plastic tank with a capacity of 200 L was taken, hermetically covered, in which water was first poured and four liters of vinasse, then the 2-4 cm chopped cassava was added, previously washed to eliminate the remains. of earth and finally the capacity of the tank was completed with water up to approximately 10 cm above the mass obtained from the cassava and then kept at rest for 7 days. (Pinheiro, Santos and Fernández, 2019). After having prepared the feed mixture in a homogeneous way, a physical-chemical characterization of the new feed was carried out and it was supplied in the morning together with the diet, which was supplied again in the afternoon, but without the silage. To evaluate the productive behavior, the indicators of feed consumption and live weight of the pigs were controlled. Subsequently, feed conversion, weight gain, and mean daily gain (GMD) were calculated.

For the analysis of the results, descriptive statistics were used to determine the mean, the coefficient of variation (CV) and the standard deviation (SD). For the analysis taking into account the study animals, a completely randomized design was used. An Anova was used to verify the presence of significant differences and then a Duncan test was used to compare the means, with a degree of significance of 5% (p<0.05). The data computation system used was INFOSTAT version 1.0 according to Balzarini, et al. (2011).

3 Analysis and discussion of results

The average initial weights did not show significant differences (table 1), which allowed us to affirm that the weights were found to be homogeneous at the beginning of the investigation. Similar results were found by de Souza et al. (2018), who refer to the weight gain in pigs fed with these products.

In addition, it is observed in table 1, statistically significant differences after 15 days of the animals consuming the experimental diets with obtaining the higher mean values in the treated animals with respect to the untreated ones and in turn in the pre-fattening pigs that vinasse and silage were included in the diet, notable differences were
presented; since the animals that were supplied with 2.5% of the vinasse were those that reached the final stage of this category with the highest average weights (14.65; 29.07 and 42.85) respectively.

These results are similar to those reported by Sánchez-Torres, et.al. (2021), who obtained final weights of 41.50 kg supplying cassava silage plus vinasse; 35.98 kg offering concentrate and 36.70 kg with the supply of cassava silage, which is why it can be argued that the animals had similar capacity and use of food. The best weight gain occurred in the group of animals that were subjected to the treatment with cassava silage plus vinasse by 2.5%, an aspect that is due to the better use and assimilation of the food that mostly covered the requirements of the animal given to a better digestibility of the nutrients present in the food as a result of the acidification of the diet by the vinasse (Khieu, et.al., 2019).

These results agree with those obtained by Ribeiro, et.al. (2020), who found better conversion and live weight in pigs that consumed combinations of additives. In addition, it coincides with what was stated by Mekonnen, et.al. (2019), who pointed out that probiotic additives, if ingested in adequate amounts, have beneficial effects on the behavior of animals, considering that the probiotic response will be determined by their condition, handling and comfort, Under the same conditions.

Table 1. Effect of the inclusion of cassava and vinasse silage in the diet on the weight gain of pigs.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Gain 15 days kg</th>
<th>Gain 30 days kg</th>
<th>Gain 42 days kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>6.19a</td>
<td>16.21a</td>
<td>27.43a</td>
</tr>
<tr>
<td>Cassava silage and 2.0% vinasse</td>
<td>6.97a</td>
<td>18.53a</td>
<td>29.39a</td>
</tr>
<tr>
<td>Cassava silage and 2.5% vinasse</td>
<td>7.25a</td>
<td>21.67b</td>
<td>35.45b</td>
</tr>
<tr>
<td>EE ±</td>
<td>0.52</td>
<td>0.8</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Different letters in the same column indicate significant differences.

Table 2 shows the behavior of the average daily gain under the effects of increasing levels of vinasse together with cassava silage as a supplement to the conventional diet with the feed used showed a significant effect on the average gains obtained by animals. They behave similarly in all animals up to 15 days of the investigation. After 30 days where the treated animals presented the highest daily gains compared to the control group.

Table 2. Effect of the inclusion of cassava and vinasse silage in the diet on the weight gain of pigs.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>GMD 15 days g</th>
<th>GMD 30 days g</th>
<th>GMD 42 days g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.42a</td>
<td>0.54a</td>
<td>0.65a</td>
</tr>
<tr>
<td>Cassava silage and 2.0% vinasse</td>
<td>0.46a</td>
<td>0.62b</td>
<td>0.70b</td>
</tr>
<tr>
<td>Cassava silage and 2.5% vinasse</td>
<td>0.48c</td>
<td>0.72c</td>
<td>0.84c</td>
</tr>
<tr>
<td>EE ±</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Different letters in the same column indicate significant differences.

Regarding the feed conversion (table 3), it can be observed that there were highly significant differences between the treatments, the best being the treatment in which the animals consumed cassava silage plus 2.5% vinasse since this indicator was behaved lower than the other treatments, which indicated that the animals required less amount of food to gain one kg of live weight.

Table 3. Inclusion of cassava and vinasse silage in the diet of pre-fattening pigs and its effect on feed conversion.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>kg conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.90a</td>
</tr>
<tr>
<td>Cassava silage and 2.0% vinasse</td>
<td>2.83b</td>
</tr>
<tr>
<td>Cassava silage and 2.5% vinasse</td>
<td>2.78c</td>
</tr>
<tr>
<td>EE ±</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Different letters in the same column indicate significant differences.

Table 4 shows the results achieved on the sanitary behavior of pre-fattening pigs and there was no mortality from diarrhea in the treatment where stillage was included simultaneously with cassava silage. This
suggests that it has been possible to maintain a balanced microflora of the gastrointestinal tract, and an adequate immunological level.

In this regard, authors such as Khieu, et al. (2019), obtained similar results in temperate climates. This shows that a way to reduce the mortality of piglets in this category is undoubtedly the use of probiotics and combinations of additives in a preventive or prophylactic way.

Table 4. Behavior of health indicators in pre-fattening pigs.

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Control</th>
<th>Cassava silage and 2.5% vinasse</th>
<th>They leveled up.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency diarrhea %</td>
<td>8.55±0.02</td>
<td>2.42±0.02</td>
<td>*</td>
</tr>
<tr>
<td>Mortality diarrhea %</td>
<td>5.98±0.01</td>
<td>0±0.01</td>
<td>**</td>
</tr>
<tr>
<td>Mortality %</td>
<td>18.52±0.02</td>
<td>7.41±0.03</td>
<td>**</td>
</tr>
</tbody>
</table>

**P<0.01; *P<0.05**

Only 2.42% of the pre-fattening animals fed with the combination of cassava and vinasse silage in 2.5% presented diarrhea during the stage, while in the control there were 8.55% of animals that presented diarrhea. These results support the studies carried out by Nguyen, et al. (2021) on lactic acid as an antimicrobial organic acid, competition for adhesion receptors, competition for nutrients and stimulation of immunity.

Table 5 shows the results achieved in the study referring to general economic indicators, where when assessing the kg of meat obtained and the price at which it is marketed by the pig company for this category, the values achieved, as well as the profits, are obtain higher values when 2.5% stillage was applied, which also corresponds to the superiority achieved in the productive indicators and increases in the production of kg of meat, which makes this type of non-state production more economical in which the producer By obtaining higher weights, you will have increases in meat directed to the population and, in turn, increase the economy in production by agreements.

Table 5. Assessment of the economic performance achieved according to the proposal given in the experiment.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>kg of meat</th>
<th>Price $/Kg of weight</th>
<th>Profit $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>400.85</td>
<td>8.50</td>
<td>3407.22</td>
</tr>
<tr>
<td>Cassava silage and 2.0% vinasse</td>
<td>411.48</td>
<td>8.50</td>
<td>3497.32</td>
</tr>
<tr>
<td>Cassava silage and 2.5% vinasse</td>
<td>430.75</td>
<td>8.50</td>
<td>3661.38</td>
</tr>
</tbody>
</table>

Based on the results achieved in this study, it can be argued that cassava silage may be a good option for pig feeding, since it is a rich source of carbohydrates and energy (Leal, et al., 2019). The silage process allows the conservation of cassava for a prolonged period, which makes it a viable and profitable alternative for pig producers (Mekonnen, et al., 2019).

However, it is important to note that cassava silage may contain variable levels of cyanide, which is toxic to animals if consumed in large quantities (Li, et al., 2020). Therefore, it is necessary to carry out tests to determine the level of cyanide present in the silage before using it to feed pigs and adjust the amount of silage accordingly (Gutiérrez and Kjeldsen, 2019).

In addition, cassava silage should not be the only source of food for pigs but should be supplemented with other foods rich in protein and nutrients to ensure a balanced diet and meet the nutritional needs of the animals (Álvarez, and Díaz, 2021). It can be a good choice for swine feed, if it is tested for cyanide levels and combined with other nutrient-dense feeds for a balanced diet.
Second, distillery stillage is a by-product of ethanol production and is rich in nutrients such as protein and minerals, making it a potentially valuable source of feed for pigs (Bolaños-Morales, et al., 2020). However, it can also be high in salt content, which can affect the health of animals if fed in large amounts (Alves, and at the., 2018).

In general, the combination of cassava silage and spirit stillage can be a viable option for swine feeding if properly managed and used in balanced amounts in the diet. It is recommended to work with a pig nutritionist or veterinarian to design an appropriate diet and to always monitor the health and performance of the animals.

4 Conclusions
Cassava silage combined with vinasse at 2.5%, according to dry matter, allowed improvements in productive indicators in pre-fattening pigs, which represents economic benefits in this animal species for production processes.

References


