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Conference Paper

Preparation of Pelleted Feed Plus the Addition of Probiotics for Pigs in the Growth and Fattening Stage

"Elaboración De Balanceado Peletizado Más La Adición De Probióticos Para Cerdos En La Etapa De Crecimiento Y Engorde"

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Abstract

The present research aims to produce a pelleted feed formula for growing and fattening pigs adding probiotics in the Biological and Bromatological Sciences of the Animal Sciences Faculty at Escuela Superior Politécnica de Chimborazo. The length of the research was 60 days, for the research development related to the proximal and physicochemical analysis 12 kg of feeding formula was used, and 64 kg for the microbiological analysis. Three levels of additional probiotics were used in this research (2, 4, and 6%), to be bought with a control treatment. A completely random design was applied with two combinatory arrangement factors; where factor A corresponds to the addiction to the probiotics and the hanger B factor (0, 7, 14, and 21) days. Reporting results for the proximal analysis, which influenced, respectively, within the parameters of humidity, protein, ashes, fat, and fiber, resulting in no significant differences in the phosphorus and calcium levels. The physicochemical analysis did not significantly influence the acidity and pH, which reported significant differences within all the treatments. When determining the hanger life, it was possible to maintain good conditions as the results were maintained under the admitted amounts suggested by the norm in relation to enterobacteria, yeast, and fungi. At the same time, it was managed to obtain lactic acid bacteria, which helped inhibit the growth of pathogenic agents. In conclusion, any type of probiotics can be used.

Keywords: *Bal, probiotics, pelleted feed, growth-fattening, physicochemical proximal analysis-microbiological.*

Resumen

El presente trabajo se planteó como objetivo elaborar un balanceado peletizado para cerdos en la etapa de crecimiento-engorde más la adición de probióticos en los laboratorios de Ciencias Biológicas y Bromatología de la Facultad de Ciencias Pecuarias de la Escuela Superior Politécnica de Chimborazo. El tiempo de duración de la investigación fue de 60 días, donde se utilizaron 12 kilos de balanceado para el análisis proximal y fisicoquímico, y 64 kilos de balanceado para el análisis microbiológico. En la investigación se trabajándose con tres niveles (2, 4 y 6) % de adición de probióticos, para ser comparados con un tratamiento control. Se aplico un diseño completamente al azar con arreglo combinatorio de dos factores; donde el factor A corresponde a la adición de probióticos y el factor B la vida de percha trabajándose con (0, 7, 14 y 21) días.

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Reportando resultados para el análisis proximal, lo cual influyo respectivamente en los parámetros de humedad, proteína, cenizas, grasa, y fibra tanto para de fósforo y calcio no se reportó diferencias significativas. En el análisis fisicoquímico no influyó significativamente para acidez, tanto para pH reporto diferencias significativas en los diferentes niveles de probióticos. En el análisis microbiológico se determinó ausencia de salmonella UFC en todos los tratamientos. Al determinar la vida de percha se logró mantener buenas condiciones ya que mantuvo resultados por debajo de lo admitido por la norma tanto de, enterobacterias, levadura y mohos. A la vez que se logró mantener las bacterias ácido-lácticas las cuales ayudan a inhibir el crecimiento de agentes patógenos, se concluye hacer uso de cualquier nivel de probióticos.

Palabras Clave: *Bal, Probioticos, Alimento Peletizado, Crecimiento-Engorde, Analisis Proximal Fisicoquimico-Microbiologico.*

1. Introduction

In recent years, pig farming has changed in all its aspects. The production parameters, along with this progress, have also improved significantly; of which, animal feed is the most important economic factor today. Technology in food preparation has made it possible to improve its nutritional value through various processes, where pelleting has proven to be an alternative to improve digestibility and reduce waste, resulting in a very significant impact on the breeding results. [1]

For more than 60 years, the animal feed industry has used low-dose antibiotics to improve growth, feed efficiency and animal health. However, with the increase in antibiotic-resistant bacteria in recent years, the livestock industry is looking for new alternatives to promote cleaner production and avoid the use of additives that threaten human and animal health. Certain beneficial microorganisms known as probiotics are added to animal feed to improve their metabolism, immune system, and production. Although there are several definitions of probiotics, most define them as living organisms that have a beneficial effect on the host's intestine. Probiotics can accelerate the growth of animals without the use of antibiotics. They also stimulate digestion and help maintain a balance in the animal's intestinal flora, preventing stress due to changes in diet, handling conditions and the attack of pathogens. [2]

Among these strategies is the use of probiotics, which is increasingly the reason for a greater number of investigations in order to intervene, in some way, in the reduction of the pathogen load and, ultimately, in the improvement of the gastrointestinal clinical conditions of swine production. However, the use of probiotics is not limited only to young animals but has also been extended to fattening pigs and breeding female pigs. For this reason, a large number of in vitro studies are currently being published with different microorganisms as probiotics in pig feed. [3].

The use of probiotics is oriented as an alternative to the use of antibiotics, because it improves feed conversion and increases the capacity of the immune system of pigs in the growth-fattening stage.

The present research work addresses the main objective of preparing a pelleted feed for pigs in the growth-fattening stage with the addition of 2, 4 and 6% of probiotics. Perform the proximal analysis of the pelleted feed for pigs in the growth-fattening stage with the addition of probiotics. Determine the shelf life through microbiological tests of a pelleted feed for pigs in the growth-fattening stage at 0, 7, 14 and 21 days. And determine the best level of inclusion of probiotic levels and shelf life of the treatments under study.

2. Materials and methods

2.1. Experimental units

During the development of this research, 12 proximal analysis observations were made, which made up 4 experimental units of 1 kilo of pelleted feed per experimental unit; and for the microbiological analysis, 64 observations were made, which make up 16 experimental units of 1 kilo of pelleted feed per experimental unit.

2.2. Treatment and experimental design

2.2.1. Proximal analysis

Throughout the process, three levels of probiotics (2, 4, and 6%) in pelleted feed were used to measure their effect on pigs in the growth-fattening stage, plus a control group. A completely randomized experimental design (DCA) was applied with three repetitions, and the size of the experimental unit was equivalent to one kilo of pelleted feed.

2.2.2. Microbiological analysis

The effect of 3 levels of probiotics (2, 4, and 6%) in pelleted feed for pigs in the growth-fattening stage, plus a control group, was evaluated. A completely randomized experimental design (DCA) was applied in a combinatorial arrangement of two factors, where factor A was the levels of probiotics and factor B was the shelf life, with 4 repetitions and the size of the experimental unit equivalent to one kilo of pelleted feed.

3. Results and discussion

3.1. Proximal analysis of pelleted feed for pigs in the growth-fattening stage with the addition of probiotics

Tabla 1

Proximal analysis of pelleted feed for pigs in the growth-fattening stage with the addition of different levels of probiotics.

VARIABLES	Treatments								S.E.	Probability	Sig
	T0		T1		T2		T3				
Humidity (%)	12,6	c	12,77	b	12,93	d	12,05	a	0,03	<0,0001	**
Ashes (%)	7,33	b	7,43	b	7,72	a	7,4	b	0,05	0,0026	*
Fat (%)	8,25	a	8,13	b	8,19	ab	8,27	a	0,02	0,0016	*
Protein (%)	17,7	a	17,33	a	17,42	a	17,63	a	0,19	0,4808	sn
Fiber (%)	7,28	a	7,26	ab	7,22	b	7,25	ab	0,01	0,0327	*
Phosphorus (%)	0,43	a	0,43	a	0,43	a	0,43	a	0,0024	0,33	sn
Calcium (%)	0,26	a	0,27	a	0,26	a	0,25	a	0,01	0,3345	sn

S.E. = Standard error; **Prob.** = Probability; **Sig.** = Significance. **Prob.** ≤ 0,05: There are highly significant differences. **Prob.** ≥ 0,01: There are no statistical differences; **Prob.** ≤ 0,01: There are highly significant differences. Observations: **T0.** = 0 % probiotic. **T1.** = 2 % probiotic. **T2.** = 4 % probiotic. **T3.** = 6 % probiotic.

3.1.1. Humidity (%)

When analyzing the humidity variable in the prepared feed, significant differences were observed between all the treatments evaluated (<0.05). The treatment that presented the lowest percentage of humidity was treatment T3, in which 12.05% humidity was observed. The highest percentage of humidity was observed in treatment T2, with 12.93% humidity, as shown in Figure **1**.

According to [4], when analyzing the effect of including different levels of Vitafert in pigs during the growth stage, a lower dry matter content was found, with 72.02% higher than those found in this research. Likewise, [5], when analyzing the effect of including different levels of a microbial preparation in piglets during the post-weaning stage, a content of 77.53% dry matter was determined, a value higher than that obtained in this research.

According to [6], "During ration balancing, it is essential to know the water content of each element that will compose it; likewise, it is necessary to monitor the humidity in

the prepared feed, since levels above 8% favor the presence of insects and above 14% there is a risk of contamination by fungi and bacteria."

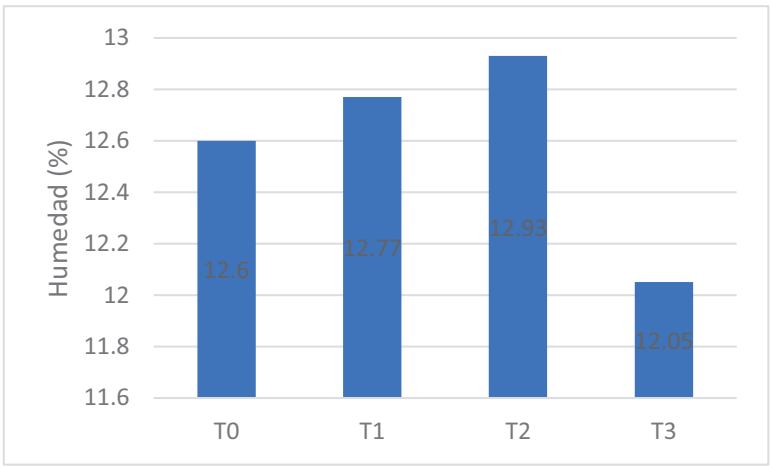

Figura 1

Humidity percentage.

3.1.2. Ashes (%)

For the variable ash contribution at different levels of probiotic addition in the production of feed, the treatments T0, T1, and T3 did not present statistical differences. Among them, T2 differs statistically from the other treatments, being the treatment with the highest percentage of ashes 7.72%. These values are represented in Figure **2**.

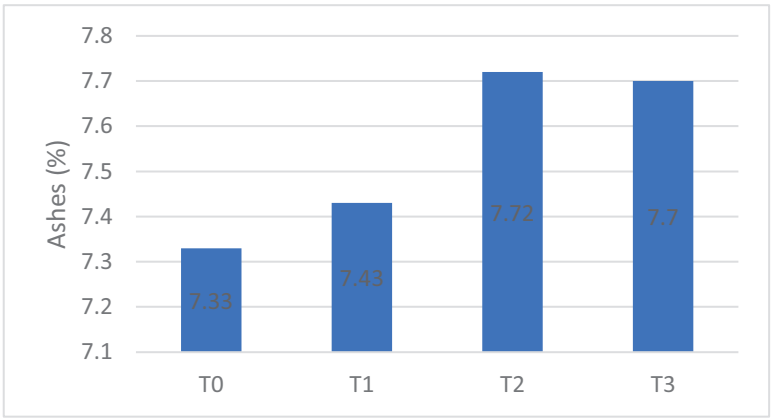

Figura 2

Ash percentage.

The percentage of ash is considered the total content of minerals or inorganic material contained in the feed. According to [7], ash can vary greatly from one feed to another, but generally the amounts of ash contained in quality feeds for pig feeding range between

6% and 9% of the total feed. Dry foods are richer in ash and wet foods have almost half as much. The values of all the treatments in this research are within the ranges set forth above.

3.1.3. Fat (%)

The fat variable in the production of feed with different levels of probiotics had the lowest value for treatment T1 with 8.13%. This percentage does not differ statistically from T2, which has the lowest value for treatment T1, with 8.13%, which does not differ statistically from T2, presenting 8.19%; The highest values were in the control treatment T0 and treatment T3, with 8.25% and 8.27% respectively, which do not differ between them. As represented in Figure **3**.

According to [5], during the post-weaning stage, there is 4.42% ethereal extract, while [4], during the growth stage, determined an ethereal extract content of 7.51%. since the ether extract content is higher in the fattening stage. All these values presented are lower than those reported in this research.

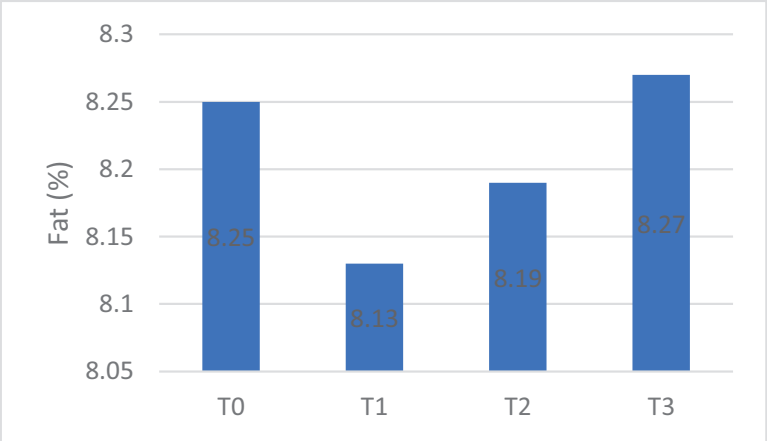

Figura 3

Fat percentage.

3.1.4. Protein (%)

In the protein variable, the highest value was recorded in treatment T0 with 17.71%. Followed by T3 with 17.63%, and the lowest value observed in treatment T1 with 17.33%. Without presenting statistical differences between treatments, the values obtained are found in Figure **4**.

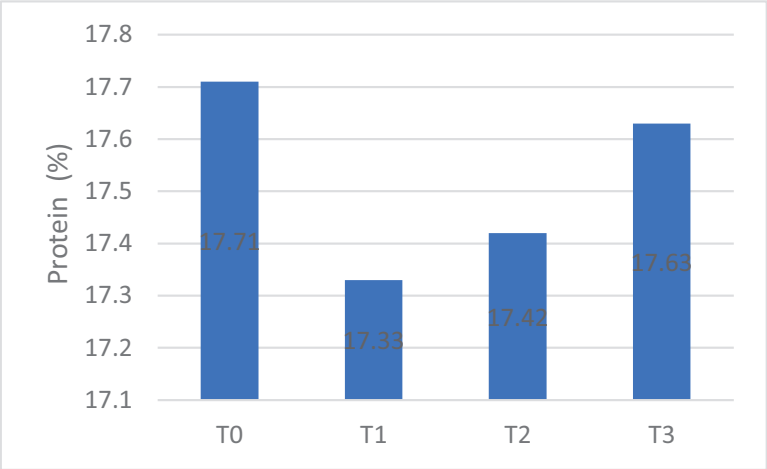

Figura 4

Protein percentage.

The data reflected in this research are below those reported by [4], who, for the purpose of including a microbial preparation vs. a commercial antibiotic in pigs in the growth stage, determined an average of 22.86%, and within the ranges reported by [6], which achieves its highest crude protein content in the microbial preparation with an average of 20.59% The control treatment has the lowest rating with an average of 14.69%, complying with the parameters of [8], who recommends that at this stage the protein content should be a minimum of 16%.

3.1.5. Fiber (%)

The fiber in the formulations with the use of different levels of probiotic achieved fiber percentages of 7.22% and 7.26% for treatments T1 and T2, respectively without presenting statistical differences between them, with the probiotic levels; That is, as the probiotic was used, the amount of fiber decreased, since the control treatment presented 7.28%, statistically different from the rest of the treatments. The values are shown in Figure **5**.

The values obtained in this variable were lower than those reported by [4], who presented an average value of 9.16% while [5], obtained an average of 9.91% and [8], a value of 8.74% in growth diets. Fiber represents the indigestible portion of feed, therefore, the higher the concentration in the feed, the lower its nutritional value. Although it is important to recommend it for the proper functioning of the intestine.

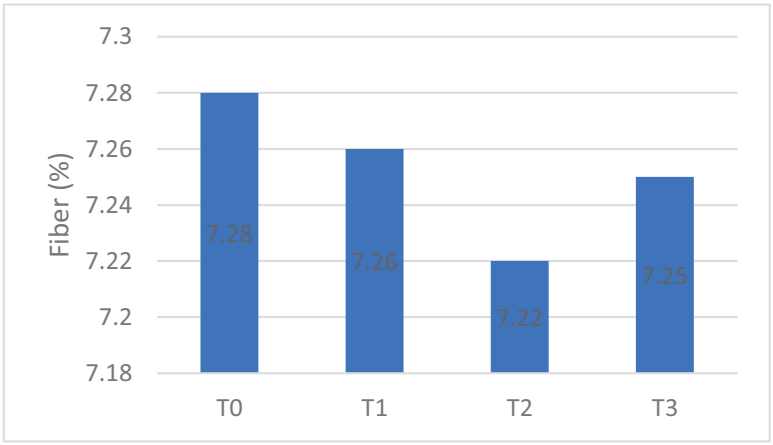

Figura 5

Fiber percentage.

3.1.6. Phosphorus (%)

When assessing the amount of phosphorus in the samples, it is observed that there are identical values for this variable. Presenting in each treatment 0.43% of phosphorus from the analyzed samples. Demonstrating that the addition of probiotics does not influence this parameter. These values are shown in Figure **6**.

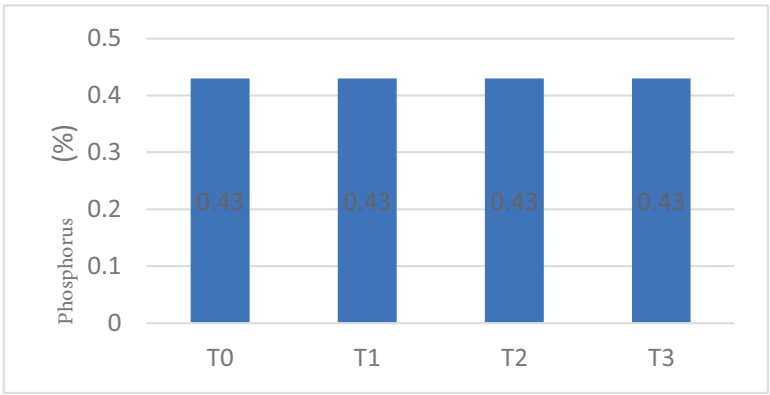

Figura 6

Phosphorus percentage.

3.1.7. Calcium (%)

When analyzing the calcium content variable, the following values were reported: in treatment T3, 0.25% calcium content was obtained in the analyzed samples, being the lowest value recorded. Additionally, in treatment T3, 0.27% calcium content was

recorded; confirming that there are no statistical differences between treatments. These values are demonstrated in Figure **7**.

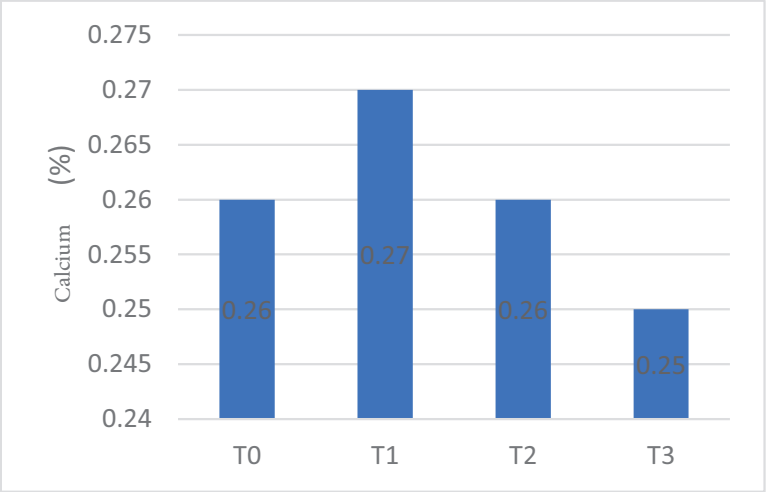

Figura 7

Calcium percentage.

3.2. Physicochemical analysis of the pelleted feed for pigs in the growth-fattening stage with the addition of different levels of probiotic

Tabla 2

Physicochemical analysis of pelleted feed for pigs in the growth-fattening stage with the addition of probiotics.

Variables	Treatments								S.E.	Probability	Sig
	T0		T1		T2		T3				
Acidity	1,36	a	1,38	a	1,38	a	1,38	a	0,01	0,5689	sn
pH	5,68	a	5,65	b	5,67	ab	5,65	b	0,01	0,0405	*

S.E. = Standard error; **Prob.** = Probability; **Sig.** = Significance. **Prob.** ≤ 0,05: Highly significant differences. **Prob.** ≥ 0,01: No statistical differences; **Prob.** ≤ 0,01: Highly significant differences. Observations: **T0.** = 0 % probiotic. **T1.** = 2 % probiotic. **T2.** = 4 % probiotic. **T3.** = 6 % probiotic.

3.2.1. Acidity

Regarding the acidity assessment, the values are represented in Figure **8**, where it is observed that the control treatment presented 1.36 degrees, being the lowest value. Additionally, there are no statistical differences from the other treatments (T1, T2, and T3), which presented 1.38 degrees each.

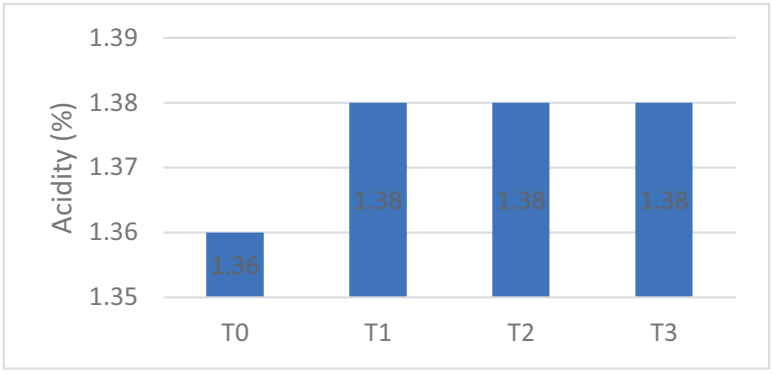

Figura 8

Acidity.

3.2.2. pH

In the pH variable of this research, the treatments present slightly acidic values, with treatments T1 and T3 presenting the lowest values with a pH of 5.65; and the control treatment presented the highest value with a pH of 5.68, with a tendency to lower the pH when probiotics are added to the feed. These values are demonstrated in Figure **9**.

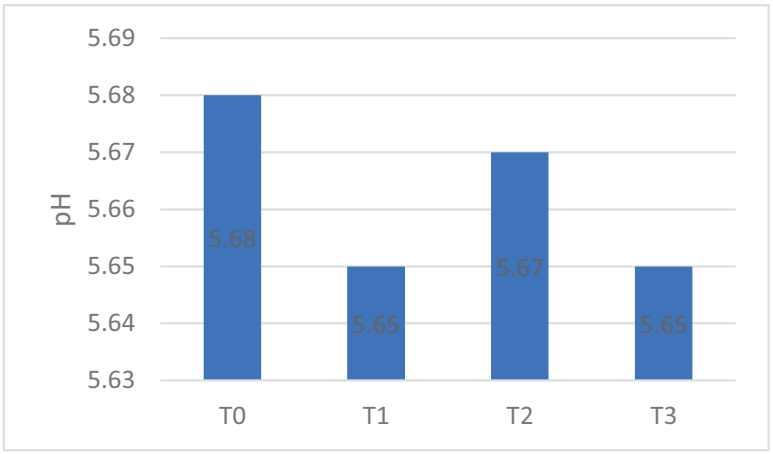

Figura 9

pH.

[9], in his study "The Influence of Probiotics on the Productive and Immune Processes of Pigs," states that probiotics carry out their action by producing antimicrobial compounds, such as acids that lower intestinal pH; competing for nutrients or adhesion sites in the intestinal epithelium with pathogenic microorganisms, altering microbial enzymatic metabolism or, alternatively, stimulating the pig's immune system.

3.3. Microbiological analysis of pelleted feed for pigs in the growth-fattening stage based on the percentage factor of probiotic

Tabla 3

Microbiological analysis of pelleted feed for pigs in the growth-fattening stage with the addition of probiotics based on the percentage factor of probiotic.

Variables	Probiotic (%)								S.E.	Prob.	Sig.
	T0		T1		T2		T3				
Yeasts and Mold	16 500,00	a	14 145,88	ab	12791,75	ab	12 625,06	b	1 010,01	0,0336	*
Enterobacteriaceae	1 583,25	a	874,88	ab	1187,44	ab	312,44	b	312,97	0,0426	*
Lactic acid bacteria	2 687,50	b	180 604,19	a	157 750,00	a	16 3916,63	a	8 154,95	<0,0001	**
Salmonella	0		0		0		0	-	-		-

S.E. = Standard error; **Prob.** = Probability; **Sig.** = Significance. **Prob.** ≤ 0,05: highly significant differences. **Prob.** ≥ 0,01: No statistical differences; **Prob.** ≤ 0,01: There are highly significant differences. Observations: **T0.** = 0 % probiotic. **T1.** = 2 % probiotic. **T2.** = 4 % probiotic. **T3.** = 6 % probiotic.

3.3.1. Yeasts and molds

When analyzing the variable of yeasts and molds in diets for pigs in the growth and fattening stage, a greater presence of yeasts was found in T0, with 16,500 CFU/g. subsequently, T1 with 14,145.88 CFU/g, there are no statistical differences between these treatments. Additionally, the lowest existence of yeasts was in the T3 treatment diets, with 12,625.06 CFU/g. Yeast has been an important source for obtaining products with probiotic activity. These products are composed of live strains that can be used as well as those derived from their walls. The latter show proven immunostimulant activity when used in farm animals as they improve digestive physiology processes and contribute to obtaining better productive results. [10]

3.3.2. Enterobacteriaceae

In the results on enterobacteria, the treatment with the least presence of them was treatment T3 with 312.44 CFU/g. showing highly significant differences than the control treatment T0 which presented 1,583.25 CFU/g. According to the total microbiological quality indicators of Enterobacteriaceae, they are within the limit allowed in the NET INEN 1829 standard.

3.3.3. Lactic acid bacteria

The lactic acid bacteria variable in its analysis shows that treatment T1 exceeds the rest of the treatments in the amount of lactic acid bacteria, with 180,604.19 CFU/g, followed by T2, with 157,750.00 CFU/g; treatment T3 presented 163,916.63 CFU/g; No statistical differences were observed between these treatments; while the control treatment T0 presented 2,687.50 CFU/g, demonstrating that there is a greater proliferation of these bacteria when adding levels of probiotics in the preparation of balanced feeds.

3.3.4. Salmonella

In the microbiological analysis carried out on the samples, the reports were negative for all treatments. This may be due to the process of obtaining them since they were made with the corresponding hygienic standards for raw materials.

3.4. Microbiological analysis of pelleted feed for pigs in the growth-fattening stage with the addition of probiotic based on shelf life.

Tabla 4

Microbiological analysis of pelleted feed for pigs in the growth-fattening stage with the addition of probiotics based on shelf life.

Variables	Day 0		Day 7		Day 14	Day 21		S.E.	Prob.	Sig.
Yeasts and Molds	22854,19	a	17291,56	b	9000,13	c	6916,81	c	1010,01	<0,0001	**
Enterobacteriaceae	1499,88	a	1590,88	a	541,50	a	395,75	a	312,97	0,0172	*
Lactic acid bacteria	225000,0	a	226187,44	a	46875,00	b	6895,88	c	8154,95	<0,0001	**
Salmonella	0		0		0	0		-	-	-

S.E. = Standard error; **Prob.** = Probability; **Sig.** = Significance. **Prob.** ≤ 0,05: There are highly significant differences. **Prob.** ≥ 0,01: There are no statistical differences **Prob.** ≤ 0,01: There are highly significant differences.

3.4.1. Yeasts and molds

For molds and yeasts, due to the effect of shelf days, the lowest values occurred at 14 and 21 days with 9,000.13 and 6,916.81 CFU/g respectively. Presenting statistical differences between the control treatment at 0 days and T1 at 7 days, to which values of 22,854.19 and 1,729.56 CFU/g were recorded. When looking at the average values, the highest content of fungi and yeast was at the beginning of the investigation, at 0

days and 7 days. In all periods the values are below the level established in the NET INEN 1829 Standard which establishes a maximum of 20,000 CFU/g.

3.4.2. Enterobacteriaceae

For the enterobacteria variable, on different days on the shelf the following results were recorded: at 0 days, 1,499.88 CFU/g, at 7 days, 1,590.88 CFU/g, and at 14 days, 541.50 CFU/g, and finally after 21 days, 395.75 CFU/g was recorded. No statistical differences were recorded between treatments and all values were recorded under the limit allowed by the INEN standard that allows a value equal to or less than 40,000 CFU/g. Considering significant contamination starting from 100,000 CFU/g and above.

3.4.3. Lactic Acid bacteria

The recorded values of lactic acid bacteria presented the lowest value at 21 days with 6,895.88 CFU/g, without presenting statistical differences with the values found at 14 days, where 46,875.00 CFU/g was recorded. The highest values were recorded on day 7 with 226,187.44 CFU/g, and on day 0 with 22,500.00 CFU/g, without presenting statistical differences between these last 2 periods.

3.4.4. Salmonella

For this variable, no presence of Salmonella colony-forming units was reported in any point in time; probably due to the presence of lactic acid bacteria which inhibit the formation of Salmonella colonies.

4. Conclusions

The inclusion of probiotics with levels of (2, 4 and 6) % in the production of pelleted feed for pigs in the growth-fattening stage determined statistical differences in the proximal analysis for the following nutrients: humidity, protein, ash, fat, and fiber, while no significant differences were reported for the phosphorus and calcium parameters.

The physicochemical analysis assessment did not significantly influence acidity, while for pH it reported significant differences in the different levels of probiotics (2, 4 and 6) %.

Regarding the microbiological analysis, the absence of salmonella CFU/g was determined in all treatments, so that correct hygiene and handling could be evidenced in the processing and preparation of pelleted feed for growing-fattening pigs.

By determining the feed's shelf life based on the different levels of probiotics, it was possible to maintain good product conditions, since it maintained results below what is admitted according to the standard, both for enterobacteria, yeast and molds.

It was possible to maintain lactic acid bacteria (LAB), which help inhibit the growth of pathogens, therefore enabling the use of any probiotic level (2, 4 and 6), in the production of feed for pigs in the growth and fattening stages. [1]

References

[1] Castillo Verde, Cr. «Influencia de la presentación del alimento en los parámetros productivos de cerdos en recría y engorde» Lima, 2015. https://hdl.handle.net/20.500.12996/2131

[2] Aceijas Quiroz, W. «Uso de Saccharomyces cerevisiae en el alimento de cerdos en acabado» Lima, 2017. https://hdl.handle.net/20.500.12996/3460

[3] Blanch A. «Prebióticos y Simbióticos En Porcino,» España, 2015. https://nutrinews.com/aplicacion-de-probioticos-prebioticos-y-simbioticos-en-porcino/.

[4] Vilatuña Moya, O. «Evaluación de diferentes niveles de vitafert en crecimiento – engorde de cerdos» 2014. http://dspace.espoch.edu.ec/handle/123456789/5289

[5] Viteri Chuquimarca, S. «Efecto de la inclusión de diferentes niveles de un preparado microbiano en porcinos en la etapa de post- destete» Riobamba, 2012. http://dspace.espoch.edu.ec/handle/123456789/5289

[6] Villacrés Barreno, J. «Probiótico natural en la alimentación de porcinos en las etapas de crecimiento y engorde con diferentes niveles de soluto» Riobamba, 2015.

[7] Márquez Siguas, B. «Cenizas y grasas» Perú, 2014. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://repositorio.unsa.edu.pe/server/api/core/bitstreams/e8bd5b97-f205-4b7e-bcd6-b34d7ab4fbe2/content

[8] Gaibor Espinoza, Cr. «Comparación de la respuesta biológica de un perobiótico comercial vs un antibiótico comercial en la etapa de crecimiento-engorde en porcinos» Riobamba, 2007. http://dspace.espoch.edu.ec/handle/123456789/2146

[9] Lessard, M. «Administration of Pediococcus acidilactici or Saccharomyces cerevisiae boulardii modulates development of porcine mucosal immunity and reduces intestinal bacterial translocation after Escherichia coli challenge» Estados Unidos, 2008. [En línea]. https://pubmed.ncbi.nlm.nih.gov/19028865/.

[10] Schrezenmeir J., de Vrese M.. «Probiotics, prebiotics, and synbiotics—approaching a definition» 2021. https://pubmed.ncbi.nlm.nih.gov/11157342/.