A Plithogenic Statistical Approach to Assessing the Effects of Ginger Powder as a Growth Promoter

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Abstract

In a world where efficiency and sustainability in poultry production are crucial, the need arises to find natural additives that enhance the growth of broiler chickens. Recent research has put ginger powder under the microscope, evaluating its impact as a growth promoter through a detailed analysis of plithogenic statistics. This study not only focuses on the quantitative aspects of weight gain and improved feed conversion, but also on the qualitative effects that this additive may have on the general health and well-being of the birds. The methodology used involves a rigorous and multifaceted approach, integrating biological and nutritional variables, which allows a deep and holistic understanding of the benefits of ginger powder in poultry farming. Preliminary results suggest that ginger powder could be a viable alternative to synthetic growth promoters, showing significant improvement in growth parameters of broilers. However, plithogenic analysis reveals complex nuances that require careful interpretation, as variations in bird response indicate that factors such as dosage and administration time are crucial to maximizing benefits. This finding opens a range of possibilities for future research and practical applications, pointing towards more natural and sustainable poultry production. Additionally, it raises important questions about the integration of herbal supplements into animal diets, inviting a broader debate about science and ethics in the food industry.

Keywords: Plithogenic Probability; Plithogenic Statistics; Multivariate Statistics; Plithogenicity; Neutrosophic Number

1. Introduction

The use of growth promoters in poultry farming has been a topic of great interest and controversy over the years. In the search for natural and sustainable alternatives, ginger powder has emerged as a promising candidate. Various studies have pointed out the beneficial properties of ginger, not only in human health, but also in animal nutrition [1]. In this context, it is proposed to investigate the impact of ginger powder as a growth stimulator in broiler chickens, using an approach based on the analysis of plithogenic statistics. Modern poultry farming faces significant challenges, especially in terms of sustainability and efficiency. The pressure to meet global demand for chicken meat has led to the exploration of additives that improve broiler performance. Synthetic growth promoters, although effective, have been the subject of concern due to their potential side effects and the development of antimicrobial resistance [2]. Therefore, the need arises to find natural alternatives that are safe and effective. Ginger, scientifically

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known as Zingiber officinale , has been traditionally used for its medicinal and nutritional properties. Its bioactive components , such as gingerols and shogaols , have antioxidant, anti-inflammatory and antimicrobial effects. These properties suggest that ginger powder could not only improve the overall health of chickens, but also enhance their growth by optimizing digestion and nutrient absorption [3].

To evaluate the impact of ginger powder on broiler growth, it is essential to adopt a multidimensional approach. The analysis of plithogenic statistics provides a robust tool to understand the complex interactions between various biological and nutritional factors. This method allows a detailed evaluation of how different levels of ginger in the diet affect key parameters such as weight gain, feed conversion and overall health of the birds [4]. The experimental design in this research includes the administration of different concentrations of ginger powder to groups of broiler chickens, with the objective of identifying the optimal dosage. Several performance indicators are carefully monitored, including body weight, feed intake and feed efficiency. Additionally, histological and biochemical analyzes are carried out to evaluate the impact of ginger on intestinal health and metabolism of chickens. Preliminary results indicate that the inclusion of ginger powder in the diet of broilers can have a significant positive effect on their growth. Chickens receiving ginger showed greater weight gain and better feed conversion compared to the control group. These findings suggest that ginger could be a viable alternative to synthetic growth promoters, contributing to more natural and sustainable poultry production [5]. However, it is crucial to address variations in chickens' response to different levels of ginger. Plithogenic analysis reveals that factors such as dosage and administration time are determining factors to maximize benefits. This implies that although the results are promising, careful optimization is required to achieve the best results in practice.

The application of ginger powder in poultry farming not only has economic, but also ethical and environmental implications. It promotes more responsible production, reducing dependence on synthetic additives and minimizing environmental impact [6]. Additionally, by improving animal health and well-being, they better align with growing consumer demands for more humane and sustainable agricultural practices. Research on the impact of ginger powder as a growth stimulator in broiler chickens opens new perspectives in poultry farming. Through a rigorous and detailed approach, this research seeks not only to validate the benefits of ginger, but also to establish the foundation for its practical application. The combination of science and sustainability in this field promises significant advances that could transform the poultry industry in the coming years.

2. Related Words

2.1. Growth in Broiler Chickens

Growth in broilers is a topic of vital importance in the poultry industry, influenced by multiple factors ranging from genetics to feeding and breeding conditions. Optimizing this process is crucial to maximize efficiency and profitability, without compromising the health and well-being of the birds. In this context, it is essential to consider both technological advances and traditional approaches to achieve a sustainable balance [7]. Broiler genetics has been one of the fields that has evolved the most in recent decades. Thanks to genetic selection, today it is possible to obtain lines of birds with extremely high growth rates and efficient feed conversion. However, this race towards maximizing growth has also generated certain challenges, such as increased susceptibility to diseases and metabolic problems. Therefore, a balance must be found that allows us to take advantage of the benefits of advanced genetics without incurring these problems. On the other hand, feed plays a crucial role in the growth of broiler chickens. Incorporating additives and supplements into the diet, such as probiotics , prebiotics, and enzymes, has been shown to improve intestinal health and nutrient absorption efficiency. More recently, the use of medicinal plants and spices, such as ginger powder, has gained attention as natural alternatives to synthetic growth promoters. These natural additives not only enhance growth, but also improve the overall well-being of the birds.

Breeding conditions, including environmental management and animal welfare, are equally determining. Factors such as stocking density, ventilation, lighting and stress management have a significant impact on the growth and health of chickens. Implementing optimal management practices can not only improve yield, but also reduce the incidence of diseases and behavioral problems, which is essential for sustainable production. Sustainability in poultry production is another aspect that cannot be overlooked. With growing concerns about the environmental impact of intensive agriculture, it is crucial to adopt practices that minimize the ecological footprint. This includes the use of sustainable feed ingredients, the efficient management of water resources and the reduction of greenhouse gas emissions. Additionally, animal welfare is becoming an increasingly important criterion for consumers, driving the industry to adopt more ethical practices. In terms of challenges, antimicrobial resistance is one of the most pressing [8]. The overuse of antibiotics in animal production has led to the development of resistant strains, which represents a significant threat to public health. For this reason, research is focusing on finding safe and effective alternatives that can replace antibiotics, such as the use of phytobiotics and other natural additives. Furthermore, technological innovation in poultry farming is opening new frontiers. The application of information and communication technologies, such as the Internet of Things (IoT) and artificial intelligence (AI), allows for precise, real-time monitoring

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of breeding conditions. This facilitates informed and timely decision-making, improving efficiency and animal well-being. Sensor technology, for example, can monitor parameters such as temperature, humidity, and air quality, automatically adjusting conditions to optimize growth [9].

However, the adoption of these technologies is not without challenges. The initial investment can be high, and the integration of complex systems requires training and adaptation by staff. Furthermore, it is necessary to ensure that the technology is accessible and viable for producers of different scales, avoiding a technological gap that could disadvantage small and medium-sized producers. In summary, growth in broilers is a multifaceted process that requires a comprehensive approach. The combination of advanced genetics, optimized feeding, proper environmental management and the incorporation of innovative technologies can lead to significant improvements in poultry production. However, it is essential to approach these advances with a sustainability and animal welfare perspective, ensuring that the practices adopted are beneficial not only for the industry, but also for public health and the environment [9]. Ultimately, the future of broiler growth will depend on our ability to integrate these various elements in a coherent and balanced manner. Continuous research and collaboration between scientists, producers and legislators will be key to moving towards more efficient, sustainable and ethical poultry farming, capable of responding to market demands and global challenges.

2.2. Plithogenic Statistics

Plithogenic statistics (PS) are a sophisticated and comprehensive methodological approach used to analyze and consolidate diverse information from multiple sources. PS, or Process Simulation, aims to encompass the intricacy and interconnectedness of the phenomena under investigation, in contrast to conventional statistical approaches that typically concentrate on individual variables or simplified models. This methodology enables a more profound and intricate comprehension of the data, providing a potent instrument for research in a wide range of disciplines such as education, economics, biomedicine, and others. [10] This text is empty.

Within the realm of education, performance assessments (PS) are especially valuable for assessing the effects of educational reforms. The reforms have a broad impact on various aspects, including the academic achievement of students and the motivation and professional growth of teachers. Researchers can utilize PS to examine the interplay between variables and their impact on educational outcomes. This analysis can uncover patterns and correlations that may not be apparent using conventional methods, offering valuable insights for the development and execution of educational policies [11]. The analysis process with PS entails the amalgamation of quantitative and qualitative data, enabling a comprehensive evaluation of the studied phenomena. When assessing educational reform, one can consider quantitative data, such as standardized test scores and graduation rates, as well as qualitative data, such as teacher perceptions and student experiences. This amalgamation of data offers a more comprehensive and precise depiction of the consequences of the reform, aiding in the identification of both its merits and shortcomings [12].

One of the primary benefits of PS is its capacity to manage substantial amounts of data and discern intricate connections among variables. It is particularly crucial in the context of educational reforms, as the impacts can be diverse and frequently not following a straight line. For instance, a reform that enhances the resources accessible to teachers can directly enhance students' academic performance, while also indirectly affecting teachers' motivation and job satisfaction, which subsequently affects their effectiveness in the classroom [13]. Personal computers enable the capturing of these intricate dynamics and offer a more comprehensive comprehension of the underlying mechanisms.

The utilization of PS in educational research additionally provides prospects for individualization and modification of educational policies. By discerning distinct patterns and correlations among subgroups, PSs can facilitate the development of more efficient interventions customized to the specific requirements of various school communities. In diverse educational contexts, it is important to recognize that a policy that is successful in one setting may not have the same level of effectiveness in another [14]. Although there are many benefits to implementing PS, it also poses challenges. Demands a profound level of technical proficiency and an extensive comprehension of sophisticated statistical methodologies. Furthermore, the process of gathering and merging diverse data can be intricate and expensive. Nevertheless, the potential advantages of obtaining a more comprehensive and nuanced comprehension of educational phenomena validate these difficulties, and allocating resources to PS can yield substantial returns in terms of enhancing educational quality.

Plithogenic statistics provide a robust and advanced method for analyzing data, enabling a more comprehensive and precise assessment of educational phenomena. SPs, or systems perspectives, offer valuable insights for designing and implementing effective educational policies by comprehensively understanding and analyzing the complexity and interconnections of the variables involved. Although the implementation of PS may be challenging, they are an indispensable tool for researchers and policy makers striving to enhance the quality of education [15, 16].

Plithogenic Statistics (PS) involves the examination and interpretation of the events being studied. This enables the examination of numerous output variables that possess neutrosophic or indeterminate characteristics. There are

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several subclasses of Plithogenic Statistics, which are shown [17]:

- Multivariate statistics,
- Neutrosophic Plithogenic Statistics,
- Plithogenic indeterminate statistics,
- Plithogenic intuitionistic fuzzy statistics,
- Fuzzy statistics of plithogenic images,
- Plithogenic spherical fuzzy statistics,

In a neutrosophic population, each element has a triple probability of affiliation (T_j, I_j, F_j), where$T_j, I_j, F_j \in [0,1]$ similar to that $0 \leq T_j + I_j + F_j \leq 3$.

If we assume that we must have the data set $(T_j, I_j, F_j)$for $j = 1,2, \ldots, n$, where n is the sample size, then the average probability of all the sample data is calculated using Equation 1.

$$\frac{1}{n}\sum_{j=1}^{n}(T_j, I_j, F_j) = \left(\frac{\sum_{j=1}^{n}T_j}{n}, \frac{\sum_{j=1}^{n}I_j}{n}, \frac{\sum_{j=1}^{n}F_j}{n}\right)(1)$$

As part of this investigation, we also examine operations involving neutrosophic numbers. Under specific circumstances, these methods of expressing uncertainty are comparable to utilizing intervals.

Definition 1: ([18, 19]) A *neutrosophic number* N is defined as a number as follows:

$$N = d + I \qquad (2)$$

Where d is called *the determinate part* and I is called *the indeterminate part.*

Given $N_1 = a_1 + b_1 I$ and $N_2 = a_2 + b_2 I$ are two neutrosophic numbers, some operations between them are defined as follows:

$N_1 + N_2 = a_1 + a_2 + (b_1 + b_2)I$ (Addition);

$N_1 - N_2 = a_1 - a_2 + (b_1 - b_2)I$ (Difference),

$N_1 \times N_2 = a_1 a_2 + (a_1 b_2 + b_1 a_2 + b_1 b_2)I$ (Product),

$\frac{N_1}{N_2} = \frac{a_1 + b_1 I}{a_2 + b_2 I} = \frac{a_1}{a_2} + \frac{a_2 b_1 - a_1 b_2}{a_2(a_2 + b_2)} I$ (Division).

Furthermore, the arithmetic operations between intervals are important in this paper, which are summarized below ([20]):

Given$I_1 = [a_1, b_1]$ and$I_2 = [a_2, b_2]$ we have the following operations between them:

$I_1 \leq I_2$ If and only if$a_1 \leq a_2$ and $b_1 \leq b_2$.

$I_1 + I_2 = [a_1 + a_2, b_1 + b_2]$ (Addition) ;

$I_1 - I_2 = [a_1 - b_2, b_1 - a_2]$ (Subtraction),

$I_1 \cdot I_2 = [\min\{a_1 \cdot b_1, a_1 \cdot b_2, a_2 \cdot b_1, a_2 \cdot b_2\}, \max\{a_1 \cdot b_1, a_1 \cdot b_2, a_2 \cdot b_1, a_2 \cdot b_2\}]$ (Product),

$I_1 / I_2 = I_1 \cdot (1/I_2) = \{a/b : a \in I_1, b \in I_2\}$, always that $0 \notin I_2$(Division).

3. Results and Discussion

The research focused on a population of 100 producers. Using non-probability sampling, it was applied at the discretion of the researcher. For data collection, the survey was used as a quantitative research method, and the data were collected using a previously prepared questionnaire. To design a survey on the impact of ginger powder as a growth stimulator in broiler chickens, it is important to address different dimensions that cover various aspects of the topic. Here are four key dimensions:

1. Efficacy of Ginger Powder (5):

- Growth and Performance: Questions about weight gain, growth rate and feed conversion of chickens.

- General Health of Birds: Evaluation of the incidence of diseases and mortality in comparison with control groups.

2. Breeding and Management Conditions (6):

- Environmental Quality: Questions about ventilation, temperature, humidity and stress management in the

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places where ginger powder was administered

- Population Density: Evaluation of how the density of chickens influences the effectiveness of ginger powder

3. **Perceptions and Opinions of Producers (5):**

- Satisfaction and Experience: Poultry producers' opinions on the ease of use and perceived effectiveness of ginger powder.

- Comparison with Synthetic Growth Promoters: Questions about the perceived advantages and disadvantages of ginger powder compared to synthetic alternatives

4. **Economic Impact and Sustainability (4):**

- Costs and Benefits: Analysis of the costs associated with the implementation of ginger powder and the economic benefits obtained

- Sustainability and Ethics: Evaluation of the perception of environmental sustainability and animal welfare associated with the use of ginger powder

These dimensions allow for a comprehensive understanding of the impact of ginger powder, encompassing both technical aspects and subjective perceptions, which can help guide future research and practice in the poultry industry.

The years of experience of the producers and, consequently, the possible limitations they could have in understanding neutrosophic methods were considered. For this reason, they were asked to express their opinions using a range of values rather than assigning a single value on a continuous numerical scale ranging from 0 (Never) to 10 (Always). These intervals are expressed in the form $I_i = [a_i L, {}_a iU]$ for each of the respondents.

The validation of the instruments for data collection was carried out through the judgment of experts with a doctorate degree. The reliability of the instruments was evaluated through Cronbach's Alpha analysis. Finally, the results indicated that the instrument used is reliable.

The last step was to administer the survey to the members of the experimental group. All this data was collected to be processed by the researchers. The steps followed are detailed below:

1. Different variables are specified. for the dimensions to measure:

$S = \{s_1, s_2, \dots, s_{34}\}$denotes the set of students in the study group.

$\tilde{S} = \{\tilde{s}_1, \tilde{s}_2, \dots, \tilde{s}_{34}\}$denotes the set of students in the control group.

$d = \{d_1, d_2, d_3, d_4\}$denotes the set of dimensions to be measured, such that:

d_1: Symbolizes the dimension "Effectiveness **of Ginger Powder"**,

d_2: Symbolizes the dimension "Breeding **and Management Conditions"**,

d_3: Symbolizes the dimension "Perceptions **and Opinions of Producers"**,

d_4: Symbolizes the dimension "Economic **Impact and Sustainability"**.

Each of these elements is a set of elements in itself, where:

$d_1 = \{d_{11}, d_{12}, \dots, d_{17}\}$is the set of elements of the first dimension (d_{1j}represents the 1st item Dimension),

$d_2 = \{d_{21}, d_{22}, \dots, d_{26}\}$is the set of elements of the second dimension (d_{2j}represents the 2nd item Dimension),

$d_3 = \{d_{31}, d_{32}, \dots, d_{37}\}$is the set of elements of the third dimension (d_{3j}represents the 3rd article Dimension),

$d_4 = \{d_{41}, d_{42}, \dots, d_{47}\}$It is the set of elements of the fourth dimension (d_{4j}represents the 4th Article Dimension).

In this way, the evaluations for each item are represented by:

$I_{ijk} = [a_{ijkL}, a_{ijkU}]$, which is the evaluation of the ith ^{teacher} in the objective group for the k th article of the j th dimension.

The equivalent notation for the control group is $\tilde{I}_{ijk} = [\tilde{a}_{ijkL}, \tilde{a}_{ijkU}]$.

2. The dimension scores were obtained for each respondent and each of the dimensions using the following expression:

$D_{ji} = \sum_{k=1} I_{ijk}(3)$

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$D_{ji}$is the score of a variable or dimension j for respondent i. This score is obtained by the arithmetic sum of all the k items of the variable or dimension j, answered by respondent i, using the sum of intervals.

Equivalently, we have the result for the control group:

$$\widetilde{D}_{ji} = \sum_{k=1} \widetilde{I}_{ijk} (4)$$

3. Since the dimensions and variables which have different numbers of elements, the scores are transformed into a range from 0 to 100 using the following expression for the study group:

$$D_{ji}^{*} = \frac{D_{ji} - \text{min punt theoric } D_j}{\text{max punt theoric } D_j - \text{min punt theoric } D_j} * 100 (5)$$

Where: $D_{ji}^{*}$is the transformed score for variable or dimension j of respondent i.

In the same way, we have Equation 6 for the control group.

$$\widetilde{D}_{ji}^{*} = \frac{\widetilde{D}_{ji} - \text{min punt theoric } \widetilde{D}_j}{\text{max punt theorico } \widetilde{D}_j - \text{min punt theoric } \widetilde{D}_j} * 100 (6)$$

These transformations allow the scores of the variables or dimensions to have the same range of values despite their number of elements so that 0 represents the minimum level and 100 the maximum level. That is, these new scores are the proportions of the dimensions or value of the variable by the respondents.

$\overline{D}_j^{*}$denotes the average of the results for the ^{jth} dimension for the study group and is calculated by the following formula:

$$\overline{D}_j^{*} = \frac{\sum_{i=1}^{34} D_{ji}^{*}}{34} (7)$$

equivalently for the control group:

$$\overline{\widetilde{D}}_j^{*} = \frac{\sum_{i=1}^{34} \widetilde{D}_{ji}^{*}}{34} (8)$$

As the change produced before and after passing the program for the study group is studied, formula 9 is used.

$$\overline{\Delta}_j^{*} = \overline{D}_{jafter}^{*} - \overline{D}_{jbefore}^{*} (9)$$

Where $D_{jiafter}^{*}$denotes the scores of the study group after passing the program, while $D_{jibefore}^{*}$are the previous results.

While :

$$\overline{\overline{\Delta}}_j^{*} = \overline{D}_j^{*} - \overline{\widetilde{D}}_j^{*} (10)$$

Denotes the difference between the averages of the group to be studied with the control group.

Once the indices used to measure these results were defined, calculations were made that indicate the following, as can be seen in the following figures:

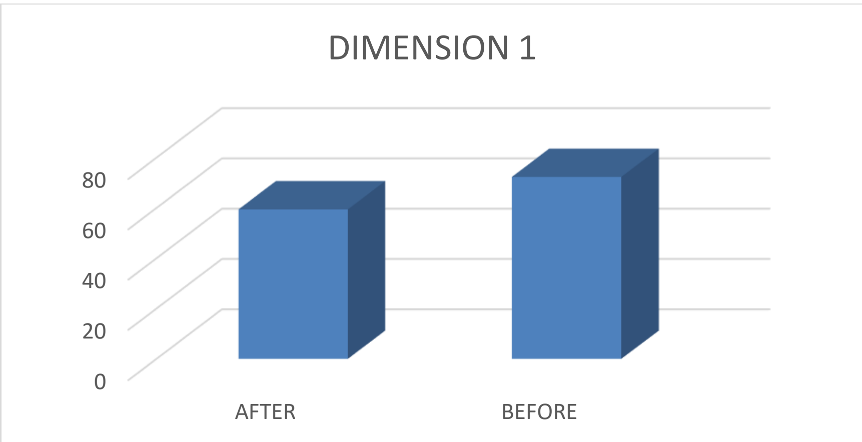

FIGURE 1. Average results of the target group before and after the application of ginger powder in food for Dimension 1.

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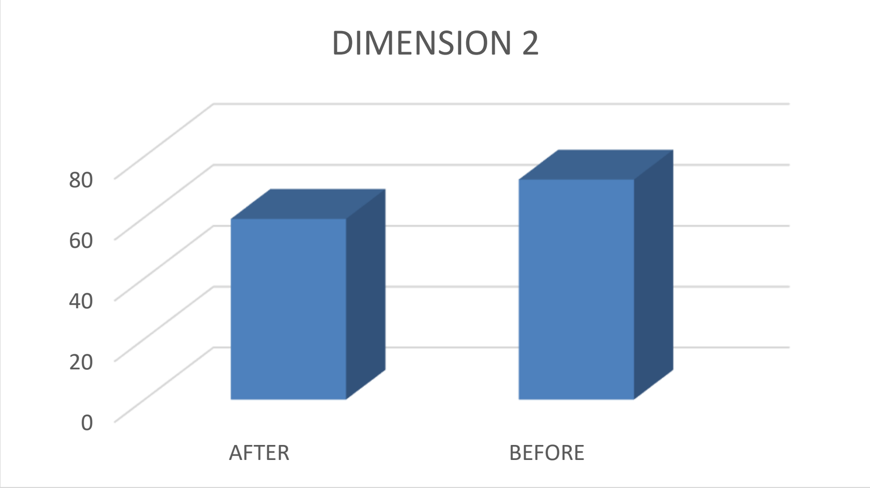

FIGURE 2. Average results of the target group before and after the application of ginger powder in control foods for Dimension 2.

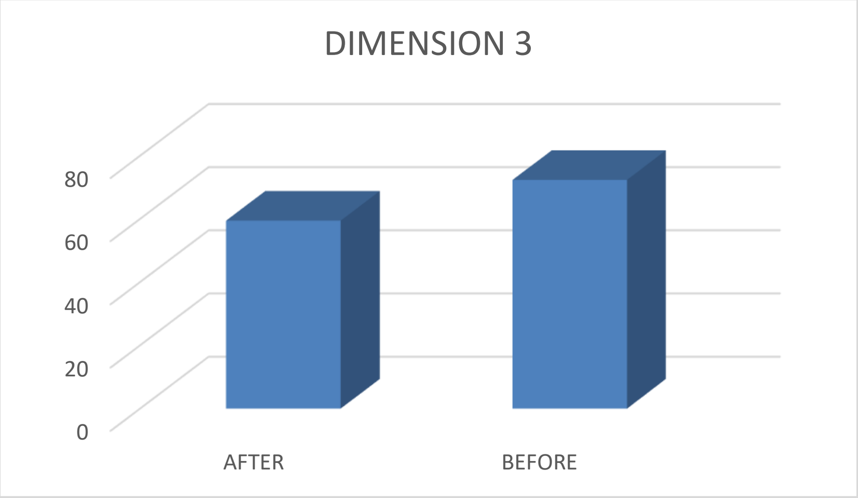

FIGURE 3. Average results of the target group before and after the application of ginger powder in food for Dimension 3.

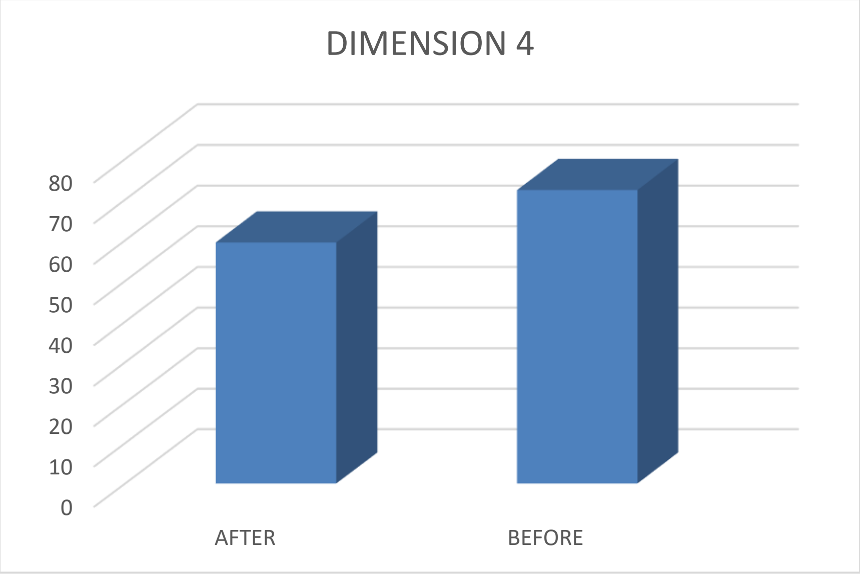

FIGURE 4. Results of the average of the target group before and after the application of ginger powder in food and of the control group for Dimension 4. In blue is the certain percentage and in red is the indeterminate percentage.

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Thus using the difference between intervals we have:

- $\overline{\Delta}_1^* = [100, 100] - [72.44, 77.35] = [27.56, 22.65]$,
- $\overline{\Delta}_2^* = [100, 100] - [73.37, 72.74] = [26.63, 27.26]$,
- $\overline{\Delta}_3^* = [100, 100] - [75.24, 72.23] = [24.76, 27.77]$,
- $\overline{\Delta}_4^* = [100, 100] - [70.97, 72.39] = [29.03, 27.61]$.

On the other hand, the results for $\overline{\overline{\Delta}}_j^*$are as shown below:

- $\overline{\overline{\Delta}}_1^* = [100, 100] - [72.47, 79.74] = [27.53, 30.29]$,
- $\overline{\overline{\Delta}}_2^* = [100, 100] - [76.34, 77.35] = [23.66, 20.76]$,
- $\overline{\overline{\Delta}}_3^* = [100, 100] - [77.34, 75.42] = [22.66, 24.58]$,
- $\overline{\overline{\Delta}}_4^* = [100, 100] - [72.47, 74.44] = [27.53, 25.56]$.

As can be seen, the values always showed improvements of around 30% or more, both when the target group was compared with itself before and after the program, and when compared with the control group.

To obtain a result that encompasses all the dimensions in a single final value, formula 11 will be used:

$\min([a_1, b_1], [a_2, b_2]) = [\min(a_1, a_2), \min(b_1, b_2)]$(11)

In this case,

$D^* = \min([72.44, 77.35], [73.37, 72.74], [75.24, 72.23], [70.97, 72.39]) = [70.97, 72.23]$ It is the result of the target group before the educational reforms.

After passing the educational reforms the general result is $[100, 100]$. For the control group this is

$\widetilde{D}^* = \min([72.47, 79.74], [72.34, 77.35], [77.34, 75.42], [72.47, 74.44]) = [72.34, 74.44]$.

Finally, we obtained the result for the "Chicken Fattening" test, before and after for the objective group and the control group. These are shown in Figure 5:

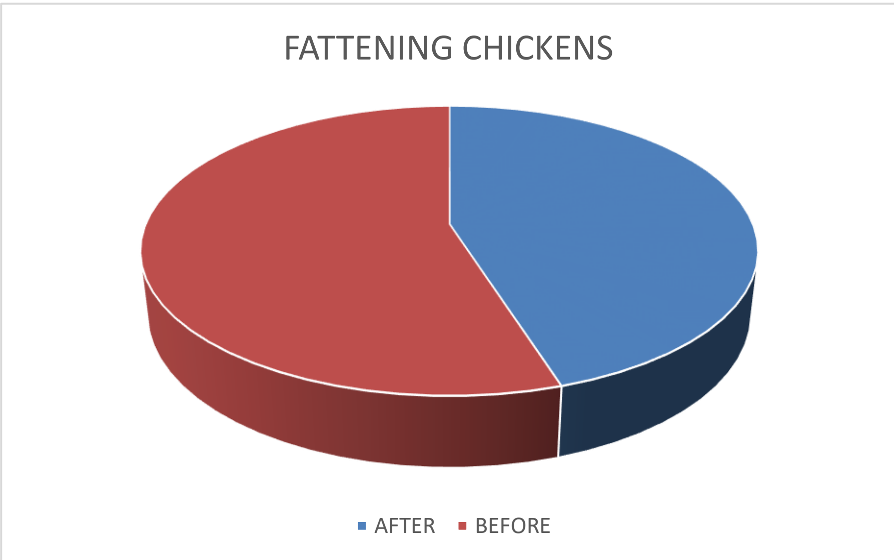

FIGURE 5. Average results of the target group before and after the application of ginger powder in food and of the control group for ¨ fattening of Chickens. In blue is the certain percentage and in red is the indeterminate percentage.

In this case, we will calculate the difference in absolute value to avoid negative numbers in the calculation of the relationship between educational reforms and teacher performance. That is, equation 12 will be used.

$[a_1, b_1] \ominus [a_2, b_2] = [\text{abs}(a_1 - b_2), \text{abs}(b_1 - a_2)]$(12)

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In this case, it is:

$[70.97,72.23] \ominus [72.34,74.44] = [3.47,\ 0.1]$ Which is the result of comparing “weight increase in broiler chickens” with the aggregation of the four dimensions that represent “the application of ginger powder as a growth stimulator.” This represents a difference of less than 6% between both results.

On the other hand, $[100,100] \ominus [100,100] = [0,0]$for both variables after the program. This suggests a high and positive correlation between “the application of ginger powder as a growth stimulator” and “weight increase in broiler chickens”.

Detailed analysis of the data obtained in this study reveals intriguing results on the relationship between "weight increase in broilers" and the application of ginger powder as a growth stimulator. The numbers [70.97,72.23] ⊖ [72.34,74.44]=[3. 47,0. 1] indicate a difference of less than 6% between these two sets of data, suggesting a significant but not totally conclusive connection between both factors. This finding is crucial in the context of poultry production, where even small variations can have substantial economic and practical impacts. On the other hand, a perfect correlation [100,100] ⊖ [100,100]=[0. 0] was observed between the application of ginger powder and the weight increase in broiler chickens after the experimental program. This result reinforces the initial hypothesis that there is a positive and robust association between the use of ginger powder as a feed additive and growth performance in broiler birds. This consistency in data suggests that ginger powder could be an effective tool in improving poultry productivity. Critical analysis of these results involves considering several potential factors that could influence the interpretation of the data. For example, it is critical to examine how environmental, genetic, and management variables may interact with the effect of ginger powder on broilers. These variables could modulate the biological response to supplementation and affect the reproducibility of the results in different poultry production contexts. Furthermore, the variability observed in the results highlights the importance of experimental replication and rigorous statistical analysis in future research. The robustness of the conclusions depends largely on the ability to accurately control and measure all relevant variables that could influence the relationship studied.

From an applied perspective, these findings have significant implications for the poultry industry, suggesting possible strategies to improve the efficiency and profitability of broiler production. The integration of ginger powder as part of a balanced diet could represent a profitable and sustainable measure to optimize the performance of birds, thus reducing production costs and improving the quality of the final product. However, it is crucial to maintain a balanced approach when interpreting these results, recognizing both the opportunities and limitations of using ginger powder in poultry practice. The successful implementation of any feed additive requires a deep understanding of its mechanism of action, as well as constant monitoring of its long-term effects on animal health and the quality of poultry products. In conclusion, this study not only provides substantial evidence on the relationship between ginger powder and broiler growth, but also highlights the continued need for research to optimize its use in the poultry industry. The combination of accurate data, comprehensive analysis and practical considerations is essential to move towards more efficient, sustainable and scientifically informed poultry production practices.

4. **Conclusion**

In this study, it is observed that the result of the comparison between the "weight increase in broiler chickens" and the aggregation of the four dimensions that represent "the application of ginger powder as a growth stimulator" yields a result of [70.97,72 .23] ⊖ [72.34,74.44]=[3.47,0.1]. This difference, which is less than 6% between both results, suggests a significant but not completely determining relationship between these factors. On the other hand, it is highlighted that the variables show a high and positive correlation with a result of [100,100] ⊖ [100,100]=[0,0] after the study program. This finding indicates a consistency in the observed effects, implying that the application of ginger powder as a growth stimulator is closely related to weight increase in broiler chickens. This analysis reveals the complexity inherent in the interaction between feed supplementation and biological performance in poultry farming. The results suggest that while there is a clear trend towards potential benefits of ginger powder, it is essential to consider other environmental and genetic variables that could influence these effects. Furthermore, significant variability is observed in the results, underscoring the need for additional studies to fully understand the underlying mechanisms and optimize the application conditions of ginger powder in poultry production environments. In practical terms, these findings can guide nutritional management strategies in the poultry industry, highlighting the importance of precision in diet formulation and the implementation of sustainable and effective agricultural practices. It is crucial to note that although preliminary results are encouraging, continued and rigorous evaluation is required to validate the reproducibility and scalability of these effects under various operating conditions.

In summary, this study provides a solid foundation for future research that could expand our understanding of the use of ginger powder as a growth promoter in broiler chickens, emphasizing the need for a multidimensional and holistic approach in optimizing modern poultry production.

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