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KNOWLEDGE TRANSFER FROM STUDENTS AND RURAL PRODUCERS ABOUT THE IMPORTANCE OF PARTICLE SIZE IN CORN SILAGE FOR DAIRY COWS

TRANSFERÊNCIA DO CONHECIMENTO AOS DISCENTES E PRODUTORES RURAIS SOBRE A IMPORTÂNCIA DO TAMANHO DE PARTÍCULAS NA SILAGEM DE MILHO PARA VACAS LEITEIRAS

TRANSFERENCIA DE CONOCIMIENTOS A ESTUDIANTES Y PRODUCTORES RURALES SOBRE LA IMPORTANCIA DEL TAMAÑO DE PARTÍCULA EN EL ENSILAJE DE MAÍZ PARA VACAS LECHERAS

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Abstract: This study aimed to guide UFGD students and rural producers on the importance of ideal particle size in corn silage for dairy cows and its influence on milk production. The work was carried out on a rural property in the Panambi District, in the municipality of Douradina, in the state of Mato Grosso do Sul. The property specializes in dairy cattle farming, where the animals' food base is corn silage. A piece of equipment called the Penn State Particle Separator was inserted into the corn silage production process, which allows estimating the quality of the corn chopping process and inferring how particle size interferes with silage quality. The action allowed those involved to see in practice the importance of ideal particle size (1 to 2 cm) when evaluating different corn silage samples with the Penn State Particle Separator and subsequently the animals' consumption and the quality of the animals' leftovers. The exchange of knowledge between academia and the field allows us to identify complex issues about the impact of the physical characteristics of food on ruminal kinetics, in order to impact the productivity of the entire rural enterprise. Students and rural producers were able to see in practice the importance of adequate particle size for the ensiling process, as it is related to forage compaction and how adequate particle size can positively influence consumption, produce rumination, salivation and adequate peristaltic movement and consequently in animal production.

Keywords: Family farming, dairy cattle, case study, rural extension.

Resumo: Objetivou-se por meio deste estudo orientar os discentes da UFGD e produtores rurais sobre a importância do tamanho de partícula ideal na silagem de milho, para vacas leiteiras e sua influência na produção de leite. O trabalho foi desenvolvido numa propriedade rural no Distrito de Panambi, no município de Douradina, no estado do Mato Grosso do Sul. A propriedade é especializada na bovinocultura leiteira, onde a base alimentar dos animais é a silagem de milho. Foi inserido no processo de produção de silagem de milho, um equipamento denominado Penn State Particle Separator, que permite estimar a qualidade do processo de picagem do milho e inferir sobre como o tamanho de partículas interferem na qualidade da silagem. A ação permitiu que os envolvidos conseguissem ver na pratica a importância do tamanho de partícula ideal (1 a 2 cm) ao avaliar diferentes amostragens de silagens milhos com o Penn State Particle Separator e posteriormente o consumo dos animais e a qualidade das sobras dos animais. A troca de conhecimento entre a academia e o campo, permiti identificar questões complexas sobre o impacto das características físicas dos alimentos sobre a cinética

ruminal, de forma a impactar a produtividade de toda empresa rural. Os discentes e os produtores rurais conseguiram ver na pratica a importância do tamanho de partícula adequado para processo de ensilagem pois está relacionado a compactação da forragem e como o tamanho de partícula adequado pode influenciar positivamente no consumo, produzir ruminação, salivação e movimentação peristáltica adequada e consequentemente na produção dos animais.

Palavras-chave: agricultura familiar, bovinos de leite, estudo de caso, extensão rural

Resumen: El objetivo de este estudio fue orientar a los estudiantes de la UFGD y a los productores rurales sobre la importancia del tamaño de partícula ideal en el ensilaje de maíz para vacas lecheras y su influencia en la producción de leche. El trabajo se realizó en una propiedad rural del distrito de Panambi, en el municipio de Douradina, en el estado de Mato Grosso do Sul. La propiedad se especializa en la producción lechera, donde la alimentación de los animales es a base de ensilado de maíz. Se insertó en el proceso de producción de ensilaje de maíz un equipo llamado Separador de Partículas Penn State, que permite estimar la calidad del proceso de picado del maíz e inferir cómo el tamaño de las partículas afecta la calidad del ensilaje. La acción permitió a los involucrados ver en la práctica la importancia del tamaño de partícula ideal (1 a 2 cm) al momento de evaluar diferentes muestras de ensilaje de maíz con el Separador de Partículas de Penn State y posteriormente el consumo de los animales y la calidad de las sobras de los animales. El intercambio de conocimientos entre la academia y el campo permite identificar cuestiones complejas respecto al impacto de las características físicas de los alimentos en la cinética ruminal, con el fin de impactar la productividad de toda la empresa rural. Los estudiantes y productores rurales pudieron constatar en la práctica la importancia del tamaño de partícula adecuado para el proceso de ensilaje ya que se relaciona con la compactación del forraje y como el tamaño de partícula adecuado puede influir positivamente en el consumo, producir rumia, salivación y movimiento peristáltico adecuado y en consecuencia en la producción animal.

Palabras clave: agricultura familiar, ganado lechero, estudio de caso, extensión rural

INTRODUCTION

University extension is a way for academics to get closer to professional experience, still in the training period. This approximation has allowed gains for both, being for the student, the contextualization between theoretical contents and practice and for the community, quality

services, since the academics will be tutored by the teaching team. This dialogical interaction through extension projects allows the university to approach the daily life of the population. To Manchur et al. (2013) "university extension is one of the ways to develop a complete academic education, which integrates theory and practice in communication with society and enables an exchange of knowledge between both".

Inserting the knowledge that the university produces through society research is a necessity and extension actions are the way to pass this knowledge on. In rural areas, the lack of information on the use of new technologies and innovations makes a more economically and environmentally sustainable form of production unfeasible, but contact with the university enables change in this scenario.

Often simple issues such as lack of maintenance of agricultural equipment, lack of control through data annotations or failure to insert control and measurement equipment for weight, consumption, production or other variables, lead small properties to bear expenses, which could be avoided with simple management adjustments or by the insertion of technologies.

Among the activities carried out by family farming, dairy farming stands out. In Brazil, corn silage constitutes the food base of many dairy herds, therefore, its production method directly influences the food quality and, consequently, the production rates.

The processing of the material to be ensiled determines its quality, being the fragmentation of the grains and the size of the particles, factors that interfere in the interaction of the ensiled material with the microorganisms responsible for the fermentation still in the silo, and subsequently, in the rumen fermentation parameters of the animals (Oliveira et al., 2019).

Particle sizes larger than 19 mm increase the selection of animals, resulting in unbalance of diets, increase in the amount of over and consequently lose if silage, besides being an indicator of high dry matter of the ensiled mass (Mertens, 1994).

The fragmentation of the grains as mentioned above is important because this process breaks the corn pericarp, making the starch more available to be used by the rumen microorganisms, preventing the corn from passing intact through the digestive tract and excreted in the feces, without being used by the animals

Adequate silage particle size distribution is an important part of diet formulation and nutritional management. The Penn State Particle Separator (PSPS), or Particle Separator is a tool that quantitatively determines the size of particles that make up a diet, helping to determine the physical characteristics of a diet, a very important factor for ruminants, which directly impacts dry matter intake and ruminal kinetics, as small particle size results in poor physical

efficiency and can impair rumination, resulting in metabolism problems such as pH drop and acidosis. And very long fiber may increase the feed selection stimulus, detecting visible leftovers in the animal trough, resulting in reduced intake and increased silage losses (Lammers et al., 1996).

Within this context, university extension actions were carried out aimed at helping and bringing new knowledge about the production of corn silage and its correct adjustment to improve the quality of the diet in dairy cattle, in a rural property in the District of Panambi, in the municipality of Douradina, Mato Grosso do Sul.

METHODOLOGY

The extension action was carried out on a property that is characterized as family farming, located in the Panambi district in the municipality of Douradina, state of Mato Grosso do Sul. The action is developed and monitored by professors and students from the Faculdade de Ciências Agrárias (FCA) of the Universidade Federal da Grande Dourados- UFGD, with financial support from the Ministry of Education (MEC) and the Pro-Rectory of Extension (PROEXT) of the Universidade Federal da Grande Dourados (UFGD).

The methodology applied was the single case study method, that is, exploratory and descriptive research, through data collection with the rural owner, through direct contact interviews with the support of a semi-structured questionnaire. For this, the following variables were considered: to this end, the following variables were considered: size of the property; number of animals; dry matter intake, animals in lactation; daily productivity, ingredients used in the animals' diets, grazing schedules corn planting, corn silage, evaluation of particle size

The property has 60 hectares, with production specialized in dairy cattle, with 45 animals in production, with a daily average of 15 liters/animal day, producing an annual average of about 600kg milk/day, reaching in some months of the year the production of 1000 kg/milk/day with about 70 animals. The animal feeding is based on the consumption of corn silage and concentrate. The silage is produced exclusively on the property, where it is harvested two to three times a year, with 80% (about 30 hectares per harvest) of the animals being fed on silage of the corn crop being destined for silage and the rest destined to compose the concentrate, formulated with ground corn, whole grain soybean (also grown on the property), minerals, urea and ammonium sulfate.

The action began in 2018 with meetings between the FCA teachers and the family of the rural producer responsible for the property, identifying and combining issues between the

technical needs brought by the family and ways to enable the inclusion of students effectively in the process, in order to combine theory to practice and research and extension, in professional training.

Through the questionnaire data, some questions were raised regarding the quality of the silage, observed by the producer that some silos led to the selection of smaller parts by the animals, rejecting the longer fiber part, combined with the increase in consumption by the animals, informed by the producer that when checking the troughs, they emptied quickly, but there was always a larger amount of the longer fiber part left over.

Within this context, evidenced by the importance of silage quality for milk production, it is extremely important to adapt all management practices that optimize the use of this food, such as the ideal point of corn for cutting, sharpening of the forage harvester knives, where the silo will be placed, ensiling time, machinery adjustments and verification of the result obtained with the silage.

The first step after studying the questionnaires was recommended by the extension group together with its coordinating professor, a visit to the silo to check general conditions, since that, it was followed how the material is handled and how it is distributed to the animals.

The silage had adequate visual aspect, no mold or fungus, no perforations in the canvas, no smell of alcohol or butylic acid indicating undesired fermentation, the color of the silage was greenish with yellow tones with a large amount of whole grains.

A sample of what is offered to the animals was collected for particle size analysis. For this evaluation a set of sieves was used that allows the separation of the material from its passage in holes of different diameters, called Penn State Particle Separator (Figure 1). On sieve 1 particles larger than 19 mm were retained, sieve 2 retained particles between 19 and 8 mm, sieve 3 particles between 8 and 1.8 mm and sieve 4 particles smaller than 1.8 mm, as proposed by Lammers et al., (1996).

Figura 1. Penn State Particle Separator.

Source: Nathálie F. Neves (2021).

A high number of particles between 8 and 1.8mm and smaller amounts of particles that fit the physically effective fiber size, which are between 19 and 8mm, were verified. In this way, a regulation of the machinery was recommended for the next ensiling, so the group of students and advising professor accompanied all the growth of the next harvest to cut the plant at the ideal point of dry matter, adjust the size of particles and check the results.

Aiming to meet the need, meetings were held with practical and theoretical explanations on techniques used for ensiling and determination of dry matter (DM) for the ideal time for harvesting and chopping the maize plant for ensiling. In the practical part, samples of the corn plant were collected in the planting area, for the determination of dry matter (DM) in a microwave oven (FMO), in the case of corn, the recommendations for ensiling the plant were when it presented average of 30% of dry material, and assuming a cutting window of 7 days, so that at the end of the harvest, the (DM) content of the plant would be around 32 to 35%.

The planting area of the corn plant was separated in order to perform material analysis at the time of harvesting and chopping (Figure 2), using a JF C120 (Pulley) Forage Harvester, year 2015 coupled to a John Deere 6115J tractor. To determine the particle size through the particle separator with sieves of different diameters.

Figura 2. Moment of cutting the entire corn plant, for silage and sample collection for particle size verification.

Source: Nathálie F. Neves. (2021).

To evaluate the particle size of the corn plant to be ensiled, 0.600 kg of chopped material was weighed, to separate the total sample into different sizes, according to its passage through the sieves. For material separation, the sieves were moved in a “back and forth” direction 10 times on each side.

Separated the sieves, the amount of material retained in each sieve was weighed, and compared to the total material of the initial sample, with this an index was generated, with this index the percentage of material in each sieve was determined if it was within a range recommendable or not.

From the implementation of this easy-to-handle technique, we can identify the following percentages by sieves, as described in Table 1.

Tabela 1. Percentage of material removed from each Penn State sieve Particle Separator from knife adjustment and corn silage cutting time.

Material	Sieve 1 >19mm	Sieve 2 19-8mm	Sieve 3 8-1.8mm	Sieve 4 <1.8mm
Pre -silage chopped corn *	5%	53%	38%	4%
ideal parameters	3-8%	45-65%	30-40%	<5%

*Corn, whole plant, harvested with an average of 30% dry matter for silage.

Source: Nathálie F. Neves. (2021).

RESULTS AND DISCUSSION

Given the importance of the single case study method as a means of investigation, and its study being relevant in the development of students, to the work experienced by the university environment, according to Rodrigo (2008), it is defined as a research category whose object is a unit that is analyze deeply.

It aims to know its "how" and its "whys", showing its unity and its own identity. It is an investigation that assumes itself as a particularist one, leaning over a specific situation, seeking to discover what is most essential and characteristic in it. Gerhardt and Silveira (2009) teach that a case study can be characterized as a study of a well-defined entity such as a program, an institution, an educational system, a person, or a social unit and that in our study, a producer rural, a rural property.

With the case analysis and the visit to the property it became clear that the animals' low consumption was due to inadequate particle size, verifying a high amount in the size between 19 and 8mm. As in this case the silage was already ready, the only suitable recommendation was to increase the humidity of the silage by adding water at the time of supplying, but for new silages it was recommended to cut the corn when the material is between 30 and 35% DM and fine tune the forage harvester blades to avoid large particle size.

Through the activity developed, the zootechnical students course had the opportunity of theoretical and practical learning of the production of corn silage, from the moment of implantation of the crop until the harvest and chopping of the material to be ensiled, handling and maintenance of the implement's agricultural products, measuring the cut of the harvester's knives and, finally, offering them to the animals (Figure 3).

Figura 3. Supply of corn silage in the trough for dairy cows.

Source: Nathálie F. Neves (2021).

By using the Penn State Particle Separator at the time of ensiling to monitor the particle size of the corn silage being produced, the farmer reported that increased corn silage consumption by dairy cows was observed. The silage had 40% particles between 8 and 1.8 mm in size, which allowed for adequate intake, rumination, and consequently better rumen health.

When evaluating two silages with different particle sizes the students and farmers observed the effects of particle size on intake. In the first case the particle size was large reducing intake and increasing selection and consequently silage waste.

In the second evaluation the particles were small, with a possible increase in the passage rate due to the larger quantities of small particles, which lead to an increase in the speed at which they leave the rumen, because they quickly reach the size needed to cross the reticulo-omasal orifice, escaping the complete ruminal digestion of fiber, which is slower, and may lead to a waste of nutrients in the feces (Gomes et al, 2012), and leading to the observed by the producer an increase in consumption.

The works and their results made it possible to identify how important the processing phase of the material to be ensiled is, and Neumann et al. (2007) points out, the size of particles is directly related to the compaction of the silo, which is crucial for achieving a suitable environment for silage fermentation.

The correct adjustment in cutting corn for silage may seem simple, since there is currently a considerable technological contribution in the agricultural sector, however, the

adjustment of the machinery at each harvest is necessary, as there is wear and small changes in the adjustments that occur with use and with the resistance imposed by the plant to the cut.

Thus, after the appropriate adjustments, it is interesting to carry out an analysis of the machine's cut, and in this sense the use of sieves can also be included, for an evaluation of the quality of the processing phase of the pre -ensiled material. The adjustment of the machinery on the property allowed reaching the appropriate indices of particle sizes for corn silage, so that it aims at a balance between the amounts that optimize the digestibility of nutrients and improve the productive indices and use of food.

The involvement of the students in the proposed activities was relevant since the attention to the details of ensilage has great relevance in the applicability of the technique in the field and this relationship between theory and practice is a process that involves a teaching methodology, characterized by learning-doing, by learning by experiencing practical knowledge. This extension of the school to the countryside is characterized by a privileged space for the production of historically constructed knowledge and continued comprehensive education in university academic education.

According to Muniz et al. (2021) when carrying out work as a demonstrative unit of compost barn confinement in a small dairy farm, the management procedures with corn until the execution of the silage also figured in knowledge and know-how, when technical information is passed on. And in this dialogue of different knowledge and practices, the experience with the construction of the shed and the handling of dairy cattle was built, making the extension activity reach other social dimensions, especially those recommended in the extension actions, those of partnerships , in which the different types of knowledge merge and give meaning to new knowledge.

In this way, the action enabled the dissemination of technologies developed through research and their insertion in the field, through rural extension. Thus, it becomes evident how important it is to bring to the rural producer, simplified forms of management that are easy to apply, which allow big changes with small actions. At the same time, integrating the university with what is the reality of the field, provides students with the experience that will be essential for good communication with rural producers, ability to solve problems and integrate what is learned in class with practice. It is extremely important to bring knowledge to the rural producer and to unite the academy with society, exchanging knowledge and generating knowledge.

In this context, other projects were created, such as the Suplementa MS, born out of the need for rural producers to have access to sustainable technologies capable of adding value to their product, combined with the need for the university, its researchers, to close cycles of

actions in society, as trainers of agricultural science professionals, builders of new technologies and facilitators of Brazilian agribusiness (Gandra et al., 2022). In this way, the Suplementa MS project, in addition to the entire process of development and dissemination of sustainable technologies, also plays a key role in training students in the Zootechnics and Agronomy course at UFGD, preparing them for the job market with competence and providing their insertion in agribusiness, especially to work in the production of dairy and beef cattle throughout the national territory.

Another example was the work with zootechnics students which Barbosa et al. (2020) implemented as activities of the Integration Program of the University to the Field - PROIN, of the State University of Montes Claros, Campus of Janaúba, which the students made visits with the objective of integrating the university students to the rural reality, allowing the technical improvement about the activities graduation practices when visiting dairy farms, stud farms, farms, feed factories, in addition to other enterprises that are directly related to the professional performance of the zootechnician, thus enabling the development of university extension through this program.

An extension action is considered successful when, besides the economic benefits brought by the solutions brought, it inserts in that environment, knowledge exchange, of the producers with the daily practice, and of the students and teachers with the theory. The exchange of experiences and subsidizes the sociability between local farmers, their neighbors and university students (Muniz et al., 2021).

In this way, the actions bring possibilities for students to share scientific knowledge with rural producers, combined with practices that are developed in the field, learning and bringing improvements to the productive processes, allowing the university to be recognized by the people in the field as an institution that can help in the direction of transformations of a reality that is often hindered by the difficulty of access to innovations and new knowledge.

Extension actions developed on the property help in milk production due to the implementation of simple technology, which is the use of Penn State Particle Separator in the corn silage manufacturing process, the basis of the property's feed. From the observed results, the importance of university extension activities in the management of family properties is evident, ensuring production in a sustainable and economical way, improving productivity without increasing the area, contributing to the preservation of natural resources and the establishment of man in the countryside. Hence the importance, according to Gandra et al. (2022), of having more incentives for extension activities that are willing to disseminate applicable technologies and also for the university to be increasingly inserted in the field,

making the interaction between teaching, research and extension a foundation that drives a more sustainable society. conscious, productive and altruistic.

FINAL CONSIDERATIONS

The action allowed for the exchange of knowledge between the academy and the field, allowing to identify in practice complex issues about the impact of the physical and chemical characteristics of foods on the rumen kinetics in dairy animals, in order to impact the productivity of every rural company. The implementation of technology allowed the correct adjustment of the corn silage processing phase, correcting the waste generated by silage with inadequate particle size.

In addition, the extension action made it possible for academics to observe in practice the situations that require advice and allows them to have the same sense of problem solving, in addition to subsidizing social exchanges between the university and the field. Therefore, it is important to say that universities play a fundamental role in the training of academics, generation of knowledge through research, and mainly in the dissemination of this knowledge through extension work.

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