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Bibliographic Review

Production of corn silage in advanced growth stages and consequence of grain processing - a review

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Abstract

The conserved foods have a big importance to planned systems of animal production. The maize plant is adapted and is grown in diverse environmental conditions of Brazil, being one of the world's most consumed cereals, having a widerange of utilization, both in the human feed as in the animal feed, combining this characteristics with high productivity of forage per area, that became the principal plant for silage. The moment of harvest of maize crop aimed to silage production is a determinant of the final cost of the process, because silage crops ensiled before the right time, shows low production, less percentage of grain in the mass and highcontent of neutral detergent fiber,on the other hand, the late harvesting of forage provides a higher dry matter accumulation and higher proportion of grains in the mass,suggesting a greater dilution of the money invested. However, with advance of corn cycle, consequently a less proportion of water is found in the plant, this fact can harm other factors in production of good quality silage, as particle size, degree of processing of the grains and the specific mass of the silo. With the production of corn silage in advanced growth stages, a higher deposition of starch in grains is observed, however, found a decline in digestibility, being mechanical processing as an alternative to improve the utilization of this important constituent of corn silage by the animals.

Keywords: Corn silage, grain processing, harvesting stage, dry matter content of the plant.

Produção de silagem de milho em estádios fenológicos avançados e consequências do processamento do grão - uma revisão

Resumo

Os alimentos conservados possuem grande importância para os sistemas planejados de produção animal. A planta de milho está adaptada e é cultivada nas mais diversas condições ambientais do Brasil. Tendo se destacado por ser um dos cereais mais consumidos do mundo, de grande diversidade de utilização, tanto na alimentação humana quanto animal, sendo uma das principais plantas cultivadas para produção de silagem. O momento de colheita da lavoura de milho visando produção de silagem é um ponto importante na determinação do custo final do processo, pois lavouras ensiladas antecipadamente ao momento propício apresentam baixa produção de massa total, menor porcentagem de grãos na massa e elevado teor de fibra em detergente neutro. Por outro lado, o corte tardio da forrageira determina maior acúmulo de massa seca e maior proporção de grãos na massa, ocorrendo uma maior diluição do capital investido. Porém, com o avanço do ciclo da cultura, é consequentemente encontrado uma menor proporção de água na planta, o que pode prejudicar fatores importantes na confecção de silagem de boa qualidade. Com a produção de silagem de milho em estádios fenológicos avançados ocorre maior deposição de amido nos grãos, entretanto, se verifica queda na sua digestibilidade, sendo, neste caso, o processamento mecânico uma alternativa para melhorar o aproveitamento digestivo desse importante constituinte da silagem de milho.

Palavras-chave: silagem, processamento de grão, ponto de colheita, teor de matéria seca da planta de milho

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Producción de ensilaje de maíz en estadios fenológicos avanzados y consecuencias del procesamiento de granos - una revisión

Resumen

Los alimentos conservados tienen una gran importancia para los sistemas planeados de producción animal. La planta de maíz es adaptada y cultivada en diferentes condiciones ambientales en Brasil. Habiendo sido destacado por ser uno de los cereales más consumidos en el mundo, con una amplia variedad de utilización, tanto en la alimentación humana y animal, siendo una de las principales plantas cultivadas para la producción de ensilaje. El momento de la cosecha de maíz para producir la ensilaje es un punto importante en la determinación del costo final del proceso, pues cultivos ensilados tempranamente presentan baja producción de masa total, baja porcentaje de granos en masa y elevada cantidad de fibra en detergente neutro. Por otro lado, el corte tardío del forraje determina una mayor acumulación de masa seca y una mayor proporción de grano en masa, disminuyendo el capital aportado. Sin embargo, con el avance del ciclo de cultivo, la planta presenta una menor proporción de agua, lo que puede perjudicar factores importantes en la fabricación de ensilaje de buena calidad. Con la producción de ensilaje de maíz en las etapas de crecimiento avanzadas se observa una mayor deposición de almidón en los granos, sin embargo, ocurre una disminución en su digestibilidad, siendo en este caso el tratamiento mecánico una alternativa para mejorar el provecho digestivo de este constituyente importante de la ensilaje de maíz .

Palabras clave: ensilaje, procesamiento de granos, puntos de cosecha, contenido de materia seca de la planta de maíz.

Introduction

Foods preserved in the silagem form have broad importance for the Brazilian livestock system, either cutting or milk, for their daily use can now be seen in large part of rural enterprises, for acting effectively in the productive efficiency of the herd.

Brazil currently has a herd of 1.15 million buffaloes, 14 million goats and 16.8 million sheep, while creation that stands out is the cattle industry, which has a herd of about 205 million heads which is the largest commercial herd in the world (MAPA, 2010), with a production of 29.48 o thousand tons of fluid milk (USDA, 2009), and 9.180 thousand tons of equivalent carcass (ABIEC, 2010); together, the production of milk and beef from Brazil generates annual revenues of approximately U.S. $ 65 billion per year.

Thinking in these so important facts to the Brazilian economy and for world food production, we have to take into account the quality of food provided to these animals, a decisive factor to ensure good health of livestock and keep a normal individual development of each animal and may so, too, provide a reduction in costs to achieve the expected result. In this sense we have the quality of forage as a reference to the nutritive value of forage mass in interaction with the consumption made by the animal and with the potential performance of the same (JOBIM et al., 2007).

According to VELHO et al. (2007), among the forages used in animal production system, corn silage has been the largest expression due to its high energy content and large production capacity per unit of area. However, according to the same author, Brazil does not have a standardization of silages produced here, occurring a deficit characterization of silage quality, among these deficits is found the measurement of the starch fraction, a very important constituent in the composition of the diet of ruminants, found in large scale in the grains of maize plants, but which often is not taken into consideration.

In the general context, the silages of maize in Brazil have average quality and production yield below the productive potential of the plant, a fact that raises the costs of production of the final material, yet, these costs of production can be modified with the adoption of some cares during the deployment and management of the crop, such cares as fertilization and neutralization of acidity in the soil, cultivar choice to be used, proper spacing, weed and pests control, choice of the right time for planting and harvesting the material, particle size, compaction time and closing of the silo, used type of the silo, condition and material used to sealing, control and management of contamination after opening of the silo. These factors listed above can be decisive on the issue of economic and qualitative production of preserved foods (BALIEIRO NETO, 2011).

Many corn hybrids are recommended annually by improvement companies, but the

recommendation for silage production is very small (NEUMANN et al., 2003), a fact that is changing nowadays. Such indications are based normally in function of the productive potential of dry mass per unit of area with base on the degree of adaptation of the materials in different regions of the country and of the chemical-bromatological characteristics of the resulting silage.

According to FACTORI (2008), the physical processing is constituted in important strategy for harvest of plants with advanced maturity stage. Combining a greater deposition of grains, greater processing of this fraction and the performance of fermentation in the silo, we can improve the nutritional quality of silage. According to JOHNSON (1999), the processing of plants in an advanced stage of maturation guaranteed a major benefit for the compaction of the material in the silo and also to the fraction grains.

The objective of this review is to gather information about the harvest time of maize crop, aiming silage production, giving special focus to the grain processing during silage making, since the advantages that the factors mentioned above may lead to the productive sector of the Brazilian cattle industry.

Stage of maturity for the harvest

Several factors are crucial to achieving a good quality silage, however, can be noted as being of greatest impact the dry matter content (DM). Current scientific recommendations indicate that the time of harvest of maize plants is determined by the dry matter content of the plant, which is not less than 30%. Soon, the stage of the plant at harvest time can alter the composition and energy values of silage, being reflected in various later aspects on silage as nutritional value, specific mass reached and type of fermentation (SALAZAR, 2009).

When you aim at good financial returns in the livestock industry, is of utmost importance that it has efficiency and scale of production, however, to meet these basic requirements in the production of silage, it must be assumed the criterion of maximum digestible energy production per unit of area (BALIEIRO NETO et al., 2011).

In this sense, when the corn grown for green forage and / or silage has the potential to provide 50 to 100% more energy per acre than any other forage plant (VELHO et al., 2007) and the harvest of a field of corn for silage enables the acquisition of about 40 to 50% more total power than when harvested for grain (FRANÇA and COELHO, 2001).

The maize plant is a very efficient in the utilization of solar radiation, absorption of H_2O and CO_2 assimilation being about 90% of its dry matter stemmed of the fixing of atmospheric elements by the process of photosynthesis (VASCONCELLOS et al. 2005).

The first point to be considered for the harvest of the crop aiming silage production is the total cost of the process, so the stage at which the plant is located has a direct relationship with this factor, that is, ensiled crops before the ideal point show low production of total mass (smaller productions of 55 Mg ha^{-1} of green matter), low grain production (less than 7 Mg ha^{-1}) (NEUMANN et al., 2011) besides possessing a higher content of neutral detergent fiber, due to the occurrence of effluents in these silages and the lower share of grains fraction in the mass (VAN SOEST, 1994; VILELA et al, 2008), characterizing an increase in the cost of obtaining the silage.

Given that for terms greater dilution of invested capital, we have to make the ensiling process following some parameters, among them stands out the reproductive dynamics of the maize plant, this being divided into different stages, classified as R1 - Corn which produced ears before grains, R2 - Bubble of water, R3 - Milky, R4 - Pasty or Farinaceous, R5 - Formation of tooth or hard and R6 - Physiological maturity (EMBRAPA, 2010), being these stages taken as the main criterion for the decision to conduct the ensiling process (Table 1).

Table 1. Contents of dry matter (DM) of different corn hybrids harvested at different reproductive stages, obtained by compilation of different works.

Works	Reproductive Stages						
	R1	R2	R3	R3-R4	R4	R5	R6
	% MS						
Ueno (2012)[1]	-	22.2	25.6	-	28.3	34.0	38.6
Neumann et al. (2011)[2]	-	-	27.1	31.6	35.9	39.4	-
Oliveira (2010)[3]	17.9	19.8	24.7	26.2	27.8	31.6	-
Salazar et al. (2010)[4]	14.7	-	-	25.2	-	-	44.8
Vilela et al. (2008)[5]	-	-	28.8	30.5	34.8	41.0	43.1
Velho et al. (2008)[6]	-	-	22.0	-	27.9	-	-
Zeoula et al. (2003)[7]	-	-	27.0	28.9	33.4	39.1	41.6
Blaser (1969)[8]	-	22.4	26.1	31.9	37.5	46.8	54.4
Average	16.3	2.5	25.9	29.1	32.2	38.7	44.5

1 Average of a hybrid (SG-6010); 2 Average of a hybrid (SG-6418) 3 Average of a hybrid (AS-1545) 4 Average of fifteen Hybrid "Top crosses"; 5 Average of four hybrids (GNZ -2004 AG-1051; P30S40 and P30F90) 6 Average of a hybrid (AG-5011); 7 Average of five hybrids (P32R21; P30R07; P3041; P30F33 and P30F80) and 8 Quoted by Nussio et al. (2001).

In the course of the cycle of the maize crop, reaching the flowering phase, the storage of nutrients in the grain begins to occur, first in simple sugars and later in starch (ZOPOLLATO, 2007). However, translocation of nutrients to the grain may lead to increases in rates of neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin of stem with advancing maturity of the plant, making this part less digestible (MASOERO et al. 2006). Yet, this was not observed in the study made by SALAZAR et al. (2010), which showed a reduction in the content of neutral detergent fiber of internodes of the stem, evaluated according to the advance of the maturity, possibly due to the storage of carbohydrates sucrose and starch.

In accordance with Neumann et al. (2007), with the advancement in grain filling, simultaneously there is a reduction in the digestibility of the fiber fraction, however, the variation in dry matter digestibility is minimal with the decrease in moisture content of the plant, which we can say that is result of the increase in the percentage of grain in the ensiled mass, suggesting a high dilution of fiber fraction in neutral detergent by starch, causing higher values of total digestible nutrients (TDN), thus allowing a higher nutritional value of forage.

Stage of Maturity *versus* Quality of Silage

According to NUSSIO et al. (2001), the ideal harvest stage corresponds to that in which the plant has higher digestible dry matter production per unit of area and moisture content in the range from 63 to 67%, which would represent the final stage of milky grain and farinaceous grain or reproductive stages R4 and R5, providing the occurrence of a compaction process and satisfactory fermentation.

Nevertheless, the recommendations of the moment for making corn silages suggests an advanced physiological stage where it is possible to reconcile higher liquid accumulation of biomass, both of grains as the plant as whole, suggesting a greater dilution of the portion of fiber in neutral detergent by starch (NEUMANN et al., 2011).

For the same authors, meanwhile, technicians and producers detect the ideal cutoff of the corn aiming at the development of the characteristics of grain fraction, in the course of the called "milk line", being indicated that this "line" is between 1/2 to 3/4 of the grain, characterizing the late stages of grain milk (R3) the beginning of hard grain (R5), respectively, according to the authors, when pressed with the fingers, the grains should get flour form instead of transforming into aqueous slurry as in full R3 stage.

Yet, WILHELM (1999) and FACTORI (2008) describe that the parameter of line of milk of the grain can induce to errors under conditions of drought, hidricoses deficits in plants with low rates of daily drying (high staygreen) because these factors can lead to an increase in duration of grain filling and consequently reduction in the rate of starch deposition.

The stage at which the crop is found at the time of silage making also presents the effect on income of the harvesting process. Being the factors maturity stage and time of ensiling process directly linked with the quality of the final product, therefore seeks to speed in preparation, which can be achieved when the ensilator is regulated to a larger particle size and higher cutting height, however, greater particle sizes may cause poor compaction of the material in the silo, as a consequence, occurs a decrease in the quality of the silage fermentation pattern (SENGER, 2005; NEUMANN et al. 2007).

As well as the particle size, the percentage of dry matter, the buffering capacity and the concentration of soluble carbohydrates of plant at harvest time can also print changes in the intensity of fermentation, concentration and the proportions between organic acids, especially lactic, acetic, propionic and n-butyric acid in silage (NUSSIO et al. 2001). These acids being responsible for the largest drop of pH on environment of silo and, when in suitable proportions confer a better quality for this material (JALČ et al. 2009).

Lactic acid should have a ratio of at least 65-70% of the total acids present in silage with ideal fermentation (SHAVER, 2003). However, JALČ et al. (2009) reached values above 83% of lactic acid testing different bacterial inoculants on silage of corn.

The guarantee of a good silage fermentation can also be given by the ratio between organic acids lactic: acetic present in the silage, according to KOC et al. (2008) this respective relationship between organic acids should not be less than 3:1, the authors that complement that the greater the relation of lactic acid compared to other acids, the better is the resulting quality of the silage (Table 2).

Table 2. Concentration of common final products of fermentation of different silages with different dry matter contents (DM).

Products	Silage of leguminous (30-40% MS)	Silage of leguminous (45-55% MS)	Silage of Grassy (30-35% MS)	Silage of maize plant (30-40% MS)	Silage of maize grain (70-75% MS)
pH	4.3 – 4.7	4.7 – 5.0	4.3 – 4.7	3.7 – 4.2	4.0 – 4.5
Ac. Lactic %	7 -8	2 - 4	6 - 10	4 - 7	0,5 – 2
Ac. Acetic%	2 - 3	0.5 – 2	1 - 3	1 - 3	< 0,5
Ac. Propionic%	< 0,5	< 0.1	< 0.1	< 0.1	< 0,1
Ac. Butyric%	< 0.5	0	0.5 – 1.0	0	0
Ethanol %	0.2 – 1.0	0.5	0.5 – 1.0	1 - 3	0.2 – 2.0
NH3-N,% of PB	10 - 15	< 12	8 - 12	5 - 7	< 10

Adopted from KUNG and SHAVER (2001);

Thus, high levels of moisture, above 70%, are correlated with undesirable characteristics in a silage, favoring the proliferation of bacteria, especially of the genus *Clostridium*, which possess attributes of produce undesirable acids during fermentation, such as the acid butyric, this acting on delaying the fall of silage pH for being a weak acid when compared with others (SILVEIRA, 2009), in addition to losing considerable amounts of nutrients and exist the risk of contaminating ground water with the production of large amounts of effluent (FACTORI, 2008).

Observations of DEMARQUILLY (1994) listed that at elevating by five percentage points the dry matter content of the corn when it is already in the reproductive stage, corresponds on average to a 5.7% increase in grain content, and when this silage is provided for steers in a feedlot, determines a positive variation of 4% in the growth rate of the animals.

Due to the advancement of maturation stage of hybrids can observe a positive correlation between the percentage of grains (R2 = 73.23%) and ear (R2 = 78.74%) and negative correlation between percentage of leaves (R2 = -85, 91%), stems (R2 = -74.76%) in the composition of the whole plant (BELEZE et al., 2003). n the foregoing, the harvesting stage of maize plants for making silage is an important factor in decision making, because this directly affects the forage production per area, the quality and the consumption of silage obtained (FACTORI, 2008).

Conciliating harvesting time and proportions of grain in ensiled mass, we can highlight the work done by NUSSIO et al. (2001), which considering the dry matter intake of silage in the stage Hard-dough (R4-R5) of the maize plant as 100% verified negative variations of up to 26% in the consumption for confined cattle, when harvested the silage on predecessors stages, this being one of the key factors that determine the levels of productivity to be achieved and consequently the economic results in a given animal production system.

When opting for a late cutting, the forage has higher dry matter accumulation and a higher proportion of grain in mass, but over the course of the cycle, consequently a smaller proportion of water is found in the plant (NEUMANN et al., 2011), which may impair another decisive factor for the making of good quality silage, the specific mass of the material.

Effect of the Stage of Harvest in Specific Mass of Silage

To obtain good quality silage is essential that the forager suffers a good process of chopping and, soon after, a great compression of the material in the silo (VELHO et al., 2007), maintaining the lowest possible concentration of oxygen interspersed to the material chopped. Conditions of anaerobiosis are important for the silage quality characteristics be similar to that of green forage (SENGER et al., 2005).

Thus, the density and the dry matter content determine the porosity of the silage, which establishes the aeration rate and subsequently the degree of deterioration in the storage and neutral detergent fiber (BOLSEN and BOLSEN, 2004; JOBIM et al. 2007). According to SILVA et al. (2011), increased penetration of air on silage during the use occurs when compression of the ensiled mass is insufficient for an adequate specific mass, which is a determining factor for the quality of the resulting silage.

The benefits of good compression on the physical and chemical characteristics of silage are observed when obtaining minimum values of specific mass of 224.46 kg MS/m^3 (MUCK and HOLMES, 2000). In accordance with JOBIM et al.

(2007), although there is a value considered ideal for evaluation in a silo, it is recommended densities exceeding 550 kg of green matter per m^3 and less than 850 kg of green matter by m3, this high value being obtained only under conditions quite favorable.

However, not only the stage where the plant is at the harvest time is linked to a good compression, there are several factors that may determine a better or worse specific mass to the silo, among which can be highlighted as of great impact: the weight and time of compression, the placed layer thickness, degree of filling of the silo and particle size (RUPPEL et al. 1995; NEUMANN, 2006).

Study evaluating compression levels and three stages of crop of the corn plant for silage performed by SENGER et al. (2005) showed better results in corn silages with higher dry matter content (> 28%) and better compression (650 kg/m3 of green matter), concluding that silage with higher dry matter preserve a greater quantity of sugars which can be used subsequently the opening of the silo by rumen microorganisms, besides having a lower ratio of neutral detergent fiber in proportion to the total of non-fibrous carbohydrates and therefore are more digestible.

According to NEUMANN (2006), smaller particle sizes in silage favor a better compaction of the material and consequently a better anaerobic fermentation, preserving the nutritional value of silage, minimizing the losses of dry matter and possible loss at the time of neutral detergent fiber and animal feeding, but this fact can be associated with a significant increase in the production of effluents.

However, RUPPEL et al. (1995) revealed no significant differences when correlated factors dry matter content and compression in silage of alfalfa. Now D'AMOURS and SOVOIE (2005) evaluating corn silage, reported that the processing of silage and percentage of grains in the mass are the most important factors to increase the specific mass of the silos.

Processing of the silage of corn

The act of processing the forage to be ensiled aims to improve the physical quality of the material through a mechanical treatment of the vegetative portion and / or the grain, which is mainly performed by successive cuts seeking a standardization in the size of particles and causing disruptions in the fraction of pericarp, exposing the starch granules to the acids produced during fermentation period in the silo and increasing the contact surface of these granules to the attack of bacteria, protozoa and fungi comprising the ruminal micro-fauna (FACTORI, 2008).

Size of the particle

Under practical environment of rural properties, the particle size of the silages are highly variable and directly related to the implements used in its making, being the potency of the tractor used and the conditions of the harvester machine important factors to ensure a good sized of chopped (NEUMANN , 2006).

According to HEINRICHS et al. (1999), there is a wide variety of ways in which the particle size of forage and / or silage can be reduced. The particle size is mainly attributed to the act of harvesting the field, although discharge methods in the silo, method of neutral detergent fiber, forage wagon or mixers of total diet, and finally, the delivery system for animal feed, may have direct effects on the particles and causes some degree of reduction in their size.

According to ZOPOLLATO (2007), the efficient processing of silage presents benefits regarding silage quality as well as the resulting animal performance, being more significant for producers who possess large-scale exploration and which enjoy the services of machinery with the possibility of executing an efficient processing of the material.

Relation between particle size and quality of corn silage was evidenced by NEUMANN et al. (2007), which evaluate different particle sizes (0.2 to 0.6cm and 1.0 to 2.0cm for large and small particles respectively) and different cutting heights (15 cm and 39 cm for cut low and high, respectively) of the maize plant concluded that smaller particles determine improved compaction of silage by reducing temperature gradients and pH in the neutral detergent fiber when compared to silages of large particles.

The use of small particles in the making of silage can set lower production costs, lower losses during withdrawal and distribution of silage to animals, although cannot prevent loss of dry matter of the silages, especially when they present dry matter content below 30% (BALSALOBRE et al., 2001).

The particle size of the silage has favorable effect to dry matter consumption and rate of passage

of the same through the digestive tract, consequently increasing the supply of energy to the animal (KONONOFF et al. 2003). However, the smaller particle size can have a negative effect in the rumen, resulting in less rumination time and consequently lower production of bicarbonate (NEUMANN, 2006), which is important by having buffering effect of rumen environment.

According to NRC (2001), ruminant animals require a minimum ratio of fiber in their diet constitution, this being important for combining physical and chemical content of the forage and quantify their value for the functioning of the rumen. The particle size is positively correlated with the rate of passage of feed through the rumen, being agreed that particles smaller than 1.18 mm pass through the sphincter which connects the reticulum-rumen to abomasum, however, for the particles larger than this value follow the normal flow of digestion they have to be reduced and as a result, these particles stimulate the secretion of saliva and buffering of the rumen (MERTENS, 1997).

Several studies were conducted using different sizes of particles in forage (DE BOEVER et al., 1993; SCHWAB et al., 2002) showing that the reduction in particle size has influence in reducing rumination activity, saliva production and facilitating the occurrence of metabolic disorders. Nevertheless, KONONOFF and HEINRICHS (2003) observed no significant differences in the rumination activity, dry matter intake, ruminal pH, apparent digestion of carbohydrates, fiber and milk production of cows in early lactation when reduced the particle size of the corn silage.

As the particle of the vegetative portion in corn silage decrease in size, there is a tendency of simultaneously occur a proportional decrease in the particle size of the grains, increasing the area available for microbial attack, resulting in a greater extent of fermentation of this fraction in the rumen (SAN EMETERIO et al., 2000).

Processing of Grain in the Silage

According to FACTORI (2008), the physical processing constitutes an important strategy for the harvest of plants in an advanced stage of maturity, and with advancing cycle occurs a greater deposition of starch in the grains, so plants with dry matter less than 35% have a lower share of this nutrient in its composition, being is this case, difficult to predict the benefit of processing of the grain portion.

The primary intent of the mechanical processing is to break the outer shell of the grain and facilitate the microbial acess to the starch reserves and consequently increase total ruminal starch digestion (RÉMOND et al. 2004). However, according to these authors, the processing and the digestibility can vary according to the vitriosity of the grains.

According to OWENS and ZINN (2005), the endosperm of maize grains normally represents between 80 to 85% of its total mass, which is mainly composed of starch (80%) and this endosperm can be classified into two types: vitreous endosperm and farinaceous endosperm.

The vitreous endosperm or also called endospermacorneous, is the fraction dark yellow located more externally of the grain, the starch in this location is highly vitreous and compacted in polygonal shapes cells, wrapped in a dense protein matrix (PEREIRA et al., 2004). The farinaceous endosperm located near the center of the grain is more opaque, the starch granules contained in the endosperm possess large spheres shapes, which are poorly organized and not embedded in a protein matrix, or with a discontinuous protein matrix (OWENS and ZINN, 2005)

The matrix protein contained in starch granules mainly the vitreous endosperm is a limiting factor when it comes to availability of this carbohydrate for utilization in the animal nutrition, because it prevents the action of enzymes, bacteria and protozoa on the same (LOPES et al., 2002). According to the same author, the ensiling process may improve the availability and / or use of the starch of grains, depending on the method, the animal species and source of the grains, since the fermentation occurring in the conservation process of forage plants acts positively on the fraction grains, breaking this protein matrix and making available the starch to be harnessed in the form of volatile fatty acids in the animal metabolism.

Thus, SZASZ et al. (2007) working with maize hybrids with different textures of grain for the manufacture of silage of wet grain, concluded that the hybrids which had grains with larger vitriosity were more digestible than hybrids with grains with smaller vitriosity. The same authors, in complementation, suggest that the negative effects of higher vitriosity of grains can be circumvented by the largest grain processing and action of acids derived from the fermentation of the silage. However,

CORONA et al. (2006) only observed improvements in the digestibility of the grain at high vitriosity when subjected to flocculation, suggesting improvements at the level of total carbohydrates and protein.

Soon the processing of grain in the silage, especially in cases of crop in advanced reproductive stage, has a great relationship with the effective degradability of dry matter. FACTORI (2008), using machinery for the manufacture of silage of wet grains for bags silos, regulated to take effect only at the level of grain from the corn silage harvested at different times, being these with a grain one quarter milky and its physiological maturity, concluded that the largest grain processing influenced in a greater ruminal degradability, presenting average of 59, 48 and 44% for the treatment with crushing of the silage and 50, 40 and 36% for the treatment without the crushing of the silage, for the passage rates of 2, 5 and 8% h-1, respectively.

When evaluating the effective degradability of dry matter of silage of maize, CORRÊA et al. (2003) observed that those who had grain with greater vitreousness showed a small decrease of effective degradability in the rumen (64% degradability for soft texture grains and 63% for texture of hard grain). PÔSSUA (2007), observed by the technique of degradability, lower values for the silage with corn of hard texture, that is, with greater participation of the starch portion vitrea of the grain surrounded by the protein matrix, being the effective degradability of dry matter of 52; 46 and 41%, respectively for the rates of passages of 3, 5 and 8% h^{-1}.

Final Considerations

The factor that has the greatest impact on the final quality of the silage is the dry matter content, search up high production combined with high quality, a fact that can easily be seen when harvested the corn crop at advanced maturity stage. This episode may reflect a lower digestibility, especially of the stem portion, by an increase in the quantification of lignin but parallel, there is a decrease in quantifying in the levels of neutral detergent fiber, suggesting greater dilution of this fraction by nonstructural carbohydrates, especially starch. In a specific way, the corn harvest in advanced growth stages may provide greater dry matter production per area, higher accumulation of starch in grains combined with a larger processing and action of acids derived from the fermentation of the silage, can ensure better utilization of food and animal performance and consequently achieve cost reduction with the supplementation with foods of high energetic value.

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