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PhD Dissertation Abstract:

RESEARCH ON THE ACTION OF SOME INFLUENCE FACTORS ON NUTRITIONAL VALUE OF CORN SILO

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Corn silo was and is the most used energy source in feed for ruminant feed, worldwide. How to produce a corn crop of high quality has changed in recent years, becoming a science and an art. Pickling is old technology of conservation, which has been improved with the times, success being dependent on compliance silage process parameters and quality of maize crop.

A not insignificant aspect would be the selection of corn hybrids, from which we are to achieve high yields of grain, a recovery as high of fiber and nutrients to the animal. These hybrids have been improved in terms of fiber digestibility, leading to increased milk production due to increased intake. Because of climate change in recent years in Romania, farmers grow at least two hybrids of maize in different maturity groups, but to find climatic conditions favorable to reduce the risk of obtaining low yields caused by climatic factors.

The quality and nutritional value of fodder pickled depends of changes that occur in the feed undergo conservation, and secondly, the loss of nutrients that may be recorded by and during pickling time. To ensure a high nutritional value of corn silage, it should closely follow a maize crop maturity to ensure optimum level of dry matter at harvest. The problem most often encountered, is the timing of harvest, so that moisture can provide good fodder conservation. If harvesting is done in the optimum phase of vegetation, shredding should be another decisive factor in achieving a quality silo. In recent years, chopping is done with efficient equipment, which can chop a large amount of maize green mass per day, and the sizes you want, but for different reasons chopping size is adjusted at the higher (1.5 cm), and not out breaking the grain needed to release the energy for good fermentation. Settlement is another step which raises questions regarding implementation silo. It is known that optimal silo corn fermentation takes place in an anaerobic environment and well-pressed silage provides ideal conditions for removal

of oxygen from the very beginning of fermentation, reducing the mass of oxygen entering the silo during storage.

The most recent studies (Borreani et al., 2007, Muck, 2004; Mahanna et al., 2003) argue that a decisive factor in terms of quality pickled fodder, is control the aerobic fermentation (and that alteration), because most, if not all farmers store maize in the silos horizontal silo, which have a large unprotected area of air intake. To this end it recommends the silo cover with foil protection after compaction, to limit the admission of air during storage, and feed management during the year. Losses caused by alteration of fodder pickled (by rotting or moldy) varies extremely large (2 to 30%), being dependent mainly on the success of silage (Pop et al., 2006).

Realizing that corn silo is entering a major proportion in the ration of ruminants throughout the year, it must achieve a cheap and good quality fodder. To obtain a quality crop, requires compliance silage technology but also its improvement. Although farmers have adhered largely technological rigor, they are still facing significant losses in the silo mass and hence a loss of energy and nutrients. We consider that all these considerations justify the need for this study.

The research has conducted over two years and assumed the assessment of two bins each year, and factors affecting their quality processes of fermentation and nutritive value of fodder pickled. The silos used in experiments were horizontal, have a width of 8 m and 12 m respectively and length silos was 40 m, with heights between 2 and 3.5 meters and a capacity of 800 tons and 1200 tons respectively. In the silos were introduced various hybrids (hybrid grain PR38V91 and silage hybrids Monalisa and Florence), which were sown in the first decade of May and harvested during the two weeks and closed silos was made within 5 and 12 days. The silos were covered with polyethylene film and with a layer of chaff, respectively.

First, investigations have focused on the knowledge of natural factors that influence the quality of maize green mass. To this end, they did soil tests, were measured and recorded temperature and rainfall.

Equally important is the knowledge of technical parameters. Maintaining the optimum parameters of fermentation processes, involving knowledge of the optimal timing of harvest of maize, the mode of filling the silo, to achieve a good compaction and cover silo closure in the shortest time, those are the main factors affecting fermentation. Fermentation is the decisive step towards conservation of the silo as its development determines the quality and nutritional value of corn silo. Making a pickled feed quality and high nutritional value, requires obtaining a green mass of quality corn with high yields per hectare, silage compliance process, sealing the silo and a proper administration of silo feeding face after its opening.

Fodder quality studies, was assessed both in terms of sensors (the most expeditious assessment) and chemically by determining acid fermentation. Measurement of chemical

composition shows gross amount of nutrients of pickled fodder. They are recovered with the introduction of systems for assessing their nutritional value, such as INRA, NRC and DLG, for energy and protein.

Following research that studied the main factors influencing the processes of fermentation quality and nutritive value of corn silo, you can conclude the following:

A) on the main technical factors influencing, studied:

- silage corn in different growing stages (milk-wax, wax and flint), resulted in a stratification of the silo in terms of dry matter content, resulting in various fermentative processes in its mass;
- chopping green mass in size between 0.5 and 2.5 cm was supplemented by grain processing, which has favored a quick release of soluble sugars;
- filling silos in periods ranging from 5 to 12 days in both experiments, not just correlated with a corresponding compression led to obtain a density of 190 - 200 kg DM/m^3 in the sides of the silo SA, respectively, 160 kg DM/m^3 at the surface of the silo NS, in 2007, and in 2008 the lowest density values were recorded at the surface silos SA and SN, of 190 kg DM/m^3 and those 160 kg DM/m^3, density that could lead to loss of dry matter in these areas, losses of between 15% and 20%;
- cover with foil polyethylene silos SA, resulted in maintaining the low level of moisture in the silo (silo humidity ranged between 65 and 70%), and in silos SN (the surface was located a layer of about 30 cm chaff), recorded at their surface moisture was on average 75% moisture that favored the development of fungi, causing degradation of pickled fodder;
- mass average temperature silos SA and SN, in 2007 was 16.6 ºC and 19 °C respectively, except the SN area of the silo where the temperature recorded was 9.1 °C, higher than its average, activity which may be caused by fungi. Evolution of temperature in the silos SA and SN in 2008 were relatively close in value, i.e. 28.5 °C and 31 ºC, values exceeded the values of outdoor temperature, but not lower than 35 °C, the losses that occur by degradation.

B) on the pickled fodder quality and mass losses silo:

- the quality classes that ranged from pickled fodder in silo SA, in 2007, was "very good" in his surface and "good" in other places studied, and in 2008, only sample from the middle silo has a capacity "good", the rest being as "very good". In silo SN surface (2007), there were processes of putrefaction and fermentation acetic, silo quality being "mid" compared with the samples as "good", harvested from the same area in 2008. For the rest of the regions studied silo quality was "very good";
- silos mass losses caused by the processes of filling and covering the silo were assessed in 2007 to around 147 t silo (12.25% of the silo), respectively, 35000 UFL, or 78 t milk in the silo

SN, and the silo SA were recorded losses of 112 t silo (14% of the silo), representing approximately 25,000 UFL, or 56 t milk. In 2008, losses were 16,200 mass silos UFL, which correspond to 37 t milk silo SA, respectively 150 t silo, or 79 t milk in the silo SN;

- losses caused by poor coverage and filling the silo, joins and losses caused by plant respiration, and those caused by lactic bacteria, which together account for losses of about 19 to 20% of the silos studied;

C) on gross chemical composition of corn silo:

- dry matter average in silos SA and SN, in 2007, was near the value of 285.9 g/kg gross respectively 300.4 g/kg gross. The silos SA and SN, studied in 2008, the amount of dry matter determined was 344.8 g/kg crude and, respectively 295.9 g/kg gross;
- analysis performed for the determination of crude protein showed the first experience (in 2007), higher values (1.6 and 19.7 g/kg DM in the silo SA and SN) than those in literature and in the second experience values were close to those of reference literature (75 g/kg DM);
- average crude fat content of fodder pickled in both experiments (for silos containing dry approximately 300 g/kg gross) was reduced by 1.1 to 3.1 g/kg DM than in references literature (25 g/kg DM), in contrast, on the silo SA of second experience (2008), crude fat has a value close to that of literature (22 g/kg DM);
- in terms of the proportion of crude fiber, it was 6% to 9.5% higher compared with reference literature data;
- tests carried out showed a content of nitrogen-free extractive substances, similar to that found in the literature, only the first experience was different nitrogen-free extractive substance of SN silo with a lower proportion of about 8% compared with values of reference;
- average amount of crude ash from silos studied in 2007 and 2008 was within the limits recommended by the literature (56 g/kg DM and 61 g/kg DM respectively);
- proportion of neutral and acid detergent fiber in mass of silos SA and SN, studied in 2007 was on average higher by about 12 to 15% compared with the value of literature. In 2008, the highest proportions of NDF and ADF were recorded in the silo SA (the proportion of NDF was 18% higher compared with literature values for the same dry matter content, and for ADF by 14%), and NDF content in the silo SN was 14% higher than the benchmark, while the ADF with only 7.5%;
- starch content provides the most energy value of corn silo, starch content in silos studied so moving: the first experience, share it in silos studied was reduced by about 32% compared to the benchmarks, and in the second experience, starch content was reduced by only 8% in the silo SA and 12% in the silo SN compared with literature data;

- calcium in silos studied, was found in amounts ranging between 3.03 and 3.67 g/kg DM, optimum for corn silage;
- phosphorus was deficient in all samples studied (phosphorus content had values between 1.28 and 1.89 g/kg DM) compared with the reference value (2.5 g/kg DM);
- magnezium content of the samples studied in the first experience was not more than 0.55 g/kg DM. In the second experience, the magnesium content of the samples taken from the silo SA exceeded the literature (1.5 g/kg DM) with 0.14 g/kg DM and in the silo SN magnesium content was 1.07 g/kg DM;
- concentration of nitrites and nitrates were very low compared to the maximum allowed, so the silo did not present a risk of poisoning.

D) on the nutritional value of corn silo (it was appreciated by INRA, NRC and DLG systems):

- energy value (INRA system) of the silos studied in both experiments, expressed in ENL and ENV, had values for milk production between 1510 and 1520 kcal/kg DM, and for meat production, the energy of the silo was between 1540 and 1550 kcal/kg DM;
- energy value (INRA system) was expressed in feed units for milk production, resulting between 0.89 and 0.9 UFL, and for meat production between 0.84 and 0.86 UFV;
- intestinal digestible protein content conditioned by nitrogen (PDIN) was on average 46 g/kg DM in the silo SA, and 57.8 g/kg DM in the silo SN, on first experience, and in the second experience, 42.5 g/kg DM in the silo SA and 40.88 g/kg DM in the silo SN;
- average amount of PDIE, ranged between 62.3 and 65.9 g/kg DM in silos studied, values that approach those of the literature (66 g/kg DM);
- energy value of fodder pickled (NRC system) was assessed at approximately 1300 kcal/kg DM ENL in the first experience, and in the second experience, to 1430 kcal/kg DM ENL in the silo SA and 1353 kcal/kg DM ENL in silo SN;
- calorific value of the silo, assessed through the DLG, was the 1430 and 1490 kcal/kg DM ENL in first experience, and the 1720 and 1480 kcal/kg DM ENL in silos of the two experiences;
- amount of protein in the NRC assessment systems and DLG was expressed as crude protein. Mean crude protein in the silo SA and SN, studied in 2007 were 76.6 g/kg DM respectively 96.3 g/kg DM, and in 2008, the silo SA and SN, crude protein had values of 70.86 and 68.06 g/kg DM respectively;
- nutritional value of silo maize, assessed by INRA systems, NRC and DLG showed differences (ENL values determined through the NRC was lower compared with values derived from the INRA system with approximately 14% in the first experience, and 9% in the second

experience, and compared with DLG assessment system, the values were 13% and 10% lower for those experiences), in light of the chemical composition, taken into account;

- compared with INRA and DLG systems, for estimating energy, NRC system takes into account the chemical composition, the content of starch, but the NDF digestibility, which could be considered the most complex system of assessment;
- for estimating protein, however, INRA system can be considered the most definitive assessment system.

E) study on the influence factors on the nutritional value of corn silo:

- hampered growth and development of plants and cobs of corn in crop year 2007 (due to adverse climatic conditions) have resulted in increased levels of GF/kg DM, but a reduction in the amount of starch in fodder pickled, which generated lower energy value of corn silo (1300 kcal/kg DM the first experience, compared with 1400 kcal/kg DM in the second experience using the NRC assessment system);
- silage maize green mass containing DM around 250 g/kg gross, increased the pH to 4.3, a figure which reflected the instability of fermentative processes and therefore an impairment of the nutritional value of corn silo (samples that were within the conditions set had an energy value between 1230 to 1280 kcal/kg DM, using the NRC assessment system);
- not cover silos with polyethylene film or inadequate coverage, resulted in altering the surface of the silo SN, and to the side of silo SA because of water infiltration, but low density, and therefore the energy value was significantly lower;
- placing into the silo, the two hybrids of corn for silage (the feature stay green) and a hybrid maize for grain, in the silo SN (in climatic conditions from 2007), has led to a pickled mass with a larger quantity (approximately 20%) of CP, compared to silo SA, where was used a hybrid of corn for silage, and a hybrid maize for grain.

Following the experience and information gained throughout the course of his doctoral thesis, we find it appropriate to outlining the following **recommendations**:

- harvesting corn must be in the same stage of vegetation (appropriate to a dry matter content of 30 - 35%) throughout the silo filling, to prevent stratification;
- chopping maize green mass to be carried out in sizes from 1 to 2 cm, grain processing being required for a swift release of soluble sugars necessary for producing lactic acid bacteria;
- silo filling method to achieve progressive and closing to take place as soon as possible (desirable in 24 to 48 h);
- when maize green mass, to be silage, has different humidity, it is recommended that on the bottom of the silo to introduce maize with the highest content of dry matter to avoid loss of nutrients from run-off juice fermentation;

- compaction should be very good, without breaks, and the weight of machines that settlement is made, be appropriate according on the rate of filling;
- to avoid losses of dry matter by moldy and rotting, it must cover the silo with foil over to sit around with sand bags, or half of used tires;
- whereas in practice, the chemical composition is determined for a sample average and in mass of studied silos were recorded very significant differences in the amounts of chemical composition between the areas studied, the sampling is recommended for administration of pickled fodder throughout the silo.

Respecting silage technology ensures the achievement of a high quality crop with high nutritional value at a reduced price and with minimum losses.