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SILAGE OF FEEDS IN COATED TANK - A METHOD TO RECOMMEND FOR USE IN ORGANIC FARMING

Summary

Silage of green fodders in coated tanks (cylindrical bales and large-size rectangular bale wrapped with foil and foil sleeves) is recommended to be used in organic farming mainly due to low losses of nutrients and their impact on improvement of the environment. The conducted evaluation of the quality of silages of pressed beet cuttings made with the use of press for shredded materials of a Norwegian company Orkel (MP 2000 Compactor) showed its very good quality. In case of ensilage materials that are hard to be ensilaged in the organic farming there is allowed the use of determined additives supporting the processes of fermentation. It results from the conducted studies, that in case of use of applicators mounted on harvesting machines, the applicator's nozzle should be placed in such places of the picking up machine, where the green fodder is mostly loosed, what creates a large area of its contact with the additive.
***Key words**: organic farming, beet cuttings, pressing, ensiling, quality*

ZAKISZANIE PASZ W ZBIORNIKACH POWŁOKOWYCH – METODA ZALECANIA DO STOSOWANIA W ROLNICTWIE EKOLOGICZNYM

Streszczenie

Zakiszanie pasz w zbiornikach powłokowych (bele cylindryczne i wielkowymiarowe bele prostopadłościenne owijane folią i rękawy foliowe) jest zalecane do stosowania w rolnictwie ekologicznym głównie ze względu na niskie straty składników pokarmowych oraz ich wpływ na poprawę stanu środowiska. Przeprowadzona ocena jakości kiszonek z prasowanych wysłodków buraczanych sporządzonych przy użyciu prasy do materiałów rozdrobnionych norweskiej firmy Orkel (MP 2000 Compaktor) wykazała bardzo dobrą jej jakość. W przypadku zakiszania materiałów trudnokiszących się dopuszcza się w rolnictwie ekologicznym stosowanie określonych dodatków wspomagających procesy fermentacji. Z przeprowadzonych badań wynika, że w przypadku użycia aplikatorów dodatków montowanych na maszynach zbierających, dyszę aplikatora należy umieszczać w takich miejscach maszyny zbierającej, w którym pasza jest najbardziej rozluźniona, co stwarza dużą powierzchnię jego styku z dodatkiem.
***Słowa kluczowe**: rolnictwo ekologiczne, wysłodki buraczane, prasowanie, zakiszanie, jakość*

1. Introduction and purpose of the study

Ensiling as a method of preservation, is especially important when in a short period of time big volumes of succulent feed are obtained and both the climate and technical conditions do not allow for their drying. Moreover, thanks to silage, also by-products of the agricultural and food industry such as beet pulp, brewery spent grain and other ones [13, 14] may be used.

Due to ecological reasons (contamination of soils with silage juice) and small losses of nutrients, nutritive value and big nutritional usability, silages should be produced from dried silages of the content of dry matter above 30%, not higher than 45%, and maximum 50% [1, 10-12, 22].

The purpose of the study is presentation of the techniques recommended in the organic agriculture of harvesting and ensilage of plant materials in coated tanks with consideration of different additives supporting the silage process, with particular attention paid to the techniques of ensilage of shredded materials.

There are also presented the results of analysis of the quality of obtained silage from beet pulp made with the use of the press make Orkel (HP 200 Compactor model).

2. Technique of harvesting and silage

In the organic farming, silage of faded silage from plant material formed in cylindrical bales, large-size rectangular balers wrapped in foil and in foil sleeves is the recommended and more and more often used method [10, 22].

The technological process of obtaining hay silage occurs in two stages. In the first stage the green fodder is cut with the use of rotational mowers equipped with a breakdown mill or a windrow ripper, and then green fodder is scoured and faded silage is raked into rollers. In the second stage, there is the collection with balers, wrapping of bales with foil, transportation and storage. Balers compact the green fodder of the content of dry matter within the range 40-50%. Pressed green fodder in round bales or large-size rectangular bales is wrapped with self-adhesive foil 0,025-0,034 mm thick. The losses of nutrients in wilted silage obtained with the use of this method amount to approx. 4-5 %. Preparation of welted silages with the use of this method, does not result in any losses connected with the outflow of silage juices. So, it is a more advantageous method than ensilage of fresh green fodders in field piles, as it influences not only the decrease of the volume of losses of nutrients, but also the improvement of the state of the environment. Wrapping of single bales involves big consumption of foil, especially on the front side, where the number of crossings of the foil layers in the roll axis of the bale corresponds to the number of rotations of a table or the arm of a wrapping machine necessary to overlay the required number of layers. Machines for tube shielding of bales, in particular serial wrapping machines (Fig. 1) constitute an alternative solution [13, 16, 20].

Fig. 1. Tube-Line round bale silage wrapping

Equally good results are obtained in case of application of the technology of ensilage fodders in foil sleeves. Almost all the farm fodders (grass, papilionaceous plants, corn, wet corn grain, cereals, pressed beet pulp, brewer's spent grain and other ones) are suitable for being preserved in a foil sleeve. An appropriate pressing machine (drawing 2) is necessary for silaging in foil sleeves. Different types of machines are available on the market, started from simple pressing machines powered from a trailer up to self-propelled machines. Depending on the needs, there are also available different types of foil sleeves. The diameters of bags amount from 2,4 up to 3,5 m, and from 45 up to 150 m long. Silage balers are produced by many European and American companies (Kuhn, Marangon, Ag Bag International LTD, Murska). These machines consist of a power unit, collecting basket, piston and a pressing chamber and also a guide on which foil bags are located. In this technology, shredding of material into short chaff (20-40 mm) and the level of dry matter of silaged raw material within the scope of 28-35%, guarantee obtaining of good quality of silage [1, 8, 9].

Fig. 2. Silage bagger with an applicator

New solutions of stationary balers cooperating with trailers are being started to be used for forming of cylindrical bales from shredded materials (beet pulp, brewer's spent grain, chaff from whole plants of corn, shredded corn cobs and other ones) [9, 15, 17, 18].

In the group of rare producers of these machines there are two European companies: the Norwegian Orkel company (model MP 2000 Compactor) and the Austrian Göweil company (model LT-Master). Several presses make Orkel are at present operating in our country in sugar plants of the group : Pfeifer und Langen and Nordzucker. They are used for ensilage sugar beet pulp. The main operating unit of machines (Fig. 3) there constitutes an innovative chamber of bales rolling composed of driven smooth rollers and two structural rubber belts 1,2 m wide. The operating chamber is supplied via the channel from the top through an inclined chain-rail conveyor. Forming of bales occurs in the same manner as in case of a hybrid baler.

Power demand amounts to approx. 90 kW, and efficiency is within the range of 40-60 bales per hour (up to 60 t h^{-1} at the dimensions of the bale 1,2 m x 1,2 m) depending on the pressed material. The source of power there may be both the farm tractor as well as the electric electric motor.

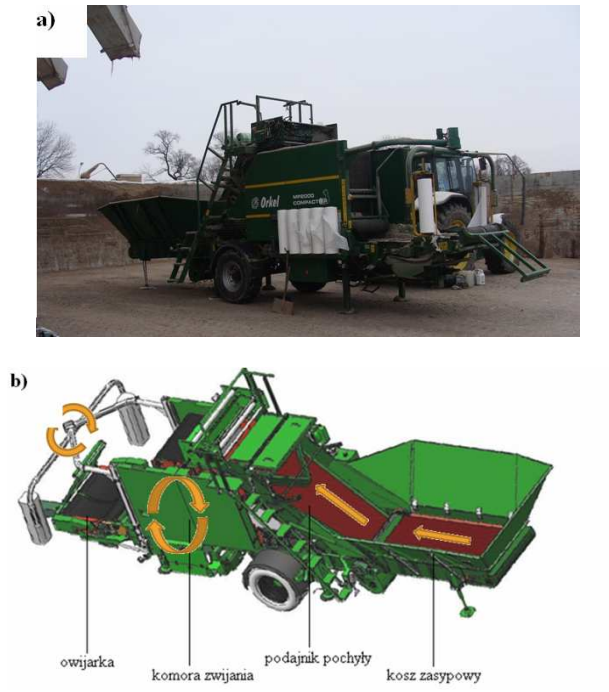

Fig. 3. Press Orkel MP 2000 Compactor: a) general view, b) construction scheme

It may be assumed, that the technology of silaging, different plant materials with the use of these balers shall be competitive for foil bags (sleeves) formed with the use of the silage baler.

3. Analysis of the silage's quality

The silage from pressed beet pulp of the content of 20% of dry matter was done with the use of an innovative press of a Norwegian Orkel company (model MP 2000 Compactor) at the territory of the sugar plant in Opalenica by Poznań, belonging to the Nordzucker Polska group. Silage in bales was stored for 8 weeks. Samples for assessment of the quality of obtained fodder were collected from 15 different places of a bale (Fig. 3) in 3 repetitions.

The scope of chemical analyses covered determination of the content of dry matter and crude ash [3]. There were also determined quality parameters of silages: pH, content of ammonia and organic acids: lactic, acetic and butyric [3].

The basic parameters of the chemical composition and the quality of silages from pressed beet pulp made in cylindrical bales are presented in table 1.

Table 1. The chemical composition and quality of pulp silage

Dry matter (g)	Crude ash (g kg^{-1} DM)	pH	Ammonia	Lactic acid	Acetic actid	Butyric acid	Quality as per Fieg-Zimmer scale	
			(g·kg^{-1} SM)				*points*	mark
279,4 ±18,5	55,03 ±2,05	3,53 ±0,03	0,85 ±0,22	68,55 ±16,39	8,95 ±1,40	0,00 0,00	100	*very good*

DM – *dry matter*

While comparing the volumes of the obtained parameters with the literature data, one should consider the type of raw material. Usually, data concerning good silages concern fodders prepared from silage's from grass, papilionaceous plants or corn.

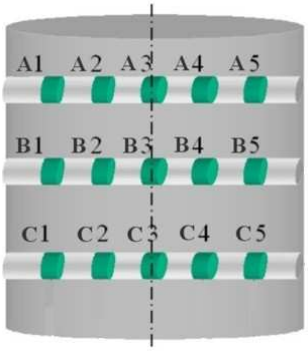

Fig. 4. Scheme of sampling sites from silo bag

The content of dry matter in the analyzed samples was characteristic for good silage from pressed beet pulp. McDonald et al. [1991] quote, that the pressed pulp are characterized by a share of dry matter within the range from 180 up to 250 g kg^{-1}. Low concentration of crude ash points out at big purity of the obtained fodder. Wilkinson [19] quotes, that in an ideal silage the content of this component should amount below 80 g kg^{-1}.

The quality of silages is defined by many parameters connected with the process of fermentation, and pH is one of the most important ones [5]. The value of this parameter was lower than given as a correct one for good silages -4,0–4,2 [19]. Fodders of low pH may be the cause of occurring acidosis in ruminants [14].

Also the content of ammonia as the product of protein disintegration is also the indicator of silages' quality. In the conducted studies, the content of this component was on a low lever (0,85 g kg^{-1} DM). In silages of good quality the content of N-NH3 constitutes less than 10% of overall N [McDonald et al 1991].

High content of the lactic acid points out at the correct process of fermentation during silage. Its content in the examined silage was high (69 g kg^{-1} DM), what constituted 88% of the total value of the content of assessed acids. At small content of acetic acid and lack of presence of butyric acid, this silage earned as per Flieg-Zimmer scale the very good mark.

In the studied silages, the content of fungistaic, that is acetic acid, amounted only to 2.5 g in fresh mass, what does not guarantee that such fodders shall be stable in oxygen conditions, after its taking out of the cylindrical bale. High concentration of lactic acid and the lack of fungistatic volatile fatty acids acting in an inhibiting manner to yeasts, may worsen the fastness of silages after their taking out from the tank. As cited by Pahlow [2004], the content of 8 g of non-dissociated acetic acid in fresh matter shows inhibiting action towards the development of fungi and yeasts, that are responsible for heating up of silages. According to Wilkinson [19], an ideal silage should include in dry matter from 20 to 30 g of acetic acid.

There was no butyric acid in the analyzed silages, what can be regarded as an ideal result [19]. The absence of butyric acid in beet pulp ensilage in cylindrical bales shows at no activity of bacteria Clostridium in the course of fermentation and – apart from the content of crude ash, is the indicator of their purity [Mc Donald et al 1991, Purwin et al 2006].

From the literature data and from own studies it results [1, 6], that the quality of silages made of beet pulp obtained during the studies is close to the quality of silages from beet pulp formed in long foil sleeves at similar efficiencies obtained in both the techniques.

4. Additives

Pursuant to the directives of the Council 2092/91 EEC, in the system of organic farming, application of additives is justified in case of ensilage grass and high-protein plants, hard to silage, characterized by low content of sugars, high content of protein and big buffer capacity. Due to that, there may be used: sea salt, coarse rock-salt, enzymes, yeasts, whey, sugar, sugar beet pulp, corn flour, molasses, and bacteria of lactic, acetic, formic and propionic acid.

Inoculants (strains) including lactic acid bacteria may be included in the group of formulas supporting the processes of fermentation.

In the production of silages, acceptable is the use of: lactic, formic, acetic and propionic acid, but only in case when the weather conditions, that is cloudy and rainy weather render it difficult to skin dry and to obtain good raw material for ensilage and obtaining correct fermentation and having it earlier agreed with an authorized certifying authority [4]. Effectiveness of activity of different additives depends on uniform placement of their determined volume of the plant matter taken to silage. They are added to the plant matter during their harvesting or at the time of loading the plants to the tank. Equipment for plants protection, waste removal trailers, fertilizer distributors or more often special applicators are used for application. In practice different additives are most often introduced during plants harvesting. For that purpose applicators assembled on harvesting machines, harvesting presses and silage presses are used. From the conducted studies it results, that the loss of preparations during their application to the harvested plant material may be considerable – even up to 60%. So, that's why the place of application of preparation to the plant material in the harvesting machine is so important [6, 7, 21].

During harvesting of green fodders with roll and large size balers, it would be the best to locate the nozzle over or after the collector, where the green fodder is loose, what creates a big area of its contact with preparation. In presses with breaking-up assemblies, it would be the best to assemble the applicator's nozzles after the breaking-up assembly

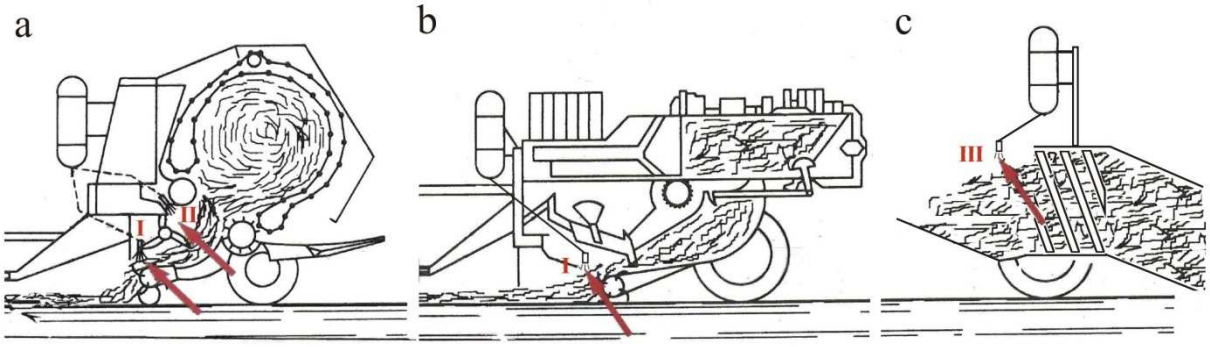

Fig. 5. Places of application of the specimen for plant material: a – in a round baler, b – in a large square baler, c – packed bag; I – over or at the rear of the pick-up unit, II – at the rear of the shredding unit, III – at the rear of charging hopper

(if construction of the machine will allow so). Green fodder cut into chaff gives a summary bigger area of contact of the plant material with preparation, so it's better mixing with green fodder (fig. 5). In case of location of applicator's nozzles according to the above recommendations, the preparation's losses amount to from some to several % [8].

In silo balers, the applicator's nozzle is located in the back part of the charge basket before the pressing chamber.

5. Summary

- In the organic farming, silage of faded silage from plant material and by products from agricultural and food industry in shell tanks (cylindrical bales and large-size rectangular bales wrapped in foil and in foil sleeves) is the recommended and more and more often used method. It is the method of ensilage characterized by low losses of nutrients (4-5%), influencing the improvement of the state of the environment.
- The conducted assessment of quality of silages from pressed beet pulp made with the use of press for shredded materials of Norwegian Orkiel company (model MP 2000 Compactor) showed, that they have a very good quality (as per Flieg-Zimmer scale 100 points – very good mark).
- In case of ensilage of materials that are hard to silage, specific additives admitted for use in organic farming and supporting the process of fermentation may be used.

Effectiveness of activity of different additives depends on uniform placement of their determined volumes in the plant matter to be ensilage. In case of use of applicators assembled on collecting balers, the nozzle (nozzles) of the applicator should be located in such places of the machine, where the material is loose as much as possible, what creates a big are of its contact with an additive.

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