Evaluation of the compost barn system of milk producers from cooperatives in the mission region

Avaliação do sistema de celeiro composto de produtores de leite de cooperativas da região de missão

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ABSTRACT
This work classifies dairy farms that use Compost Barn (CB) as a confinement system for dairy cows in the Mission Region of Rio Grande do Sul / Brazil. The Support Center for the Development of Milk Products and Processes installed in the Technological Park of URI Santo Ângelo aims to provide support to companies and milk producers in the region covered by TecnoURI. It is presented in this article that the study of the evaluation of the Compost Barn (CB) system used by milk producers of cooperatives in the Missions region of Rio Grande do Sul, which presents itself as a promising alternative for the production of raw milk, bringing better quality and welfare for the animals present in this system. This research identifies structural and handling factors that interfere with the quality of composted packaging. The data were obtained on the spot, with measurements of facilities, observations of herds and collection of technical information on dairy farms. In addition to the consolidated variables related to the handling and quality of the packaging, it is reported that the frequency of agitation, resting area per animal, presence of mechanical ventilation in the barn, the type of material used to compose the bedding package and the local relative humidity are factors that influence the main bed variables of the Composto Barn system and can be key points for the success of the CB system in subtropical regions of Brazil. This article presents the results of the study of the evaluation and improvement of the compost barn system of milk-producing members of cooperatives in the Missions region of Rio Grande do Sul, aiming at decreasing the milk CCS, as well as the identification of the microorganisms that cause mastitis. The influence of management on the quality of the bed is evident, mainly regarding the frequency of turning, correct dimensioning of the bed area, and the presence of a ventilation system. However, the good functioning of the system depends to a large extent on the adopted daily managements, which still need to be studied for a better understanding of the composting process, a key factor for success in production.

Palavras-chave: Milk, Cooperatives, Compost barn, evaluation.

RESUMO
Este trabalho classifica as fazendas leiteiras que utilizam Compost Barn (CB) como sistema de confinamento para vacas leiteiras na Região da Missão do Rio Grande do Sul / Brasil. O Centro de Apoio ao Desenvolvimento de Produtos e Processos do Leite instalado no Parque Tecnológico da URI Santo Ângelo tem como objetivo apoiar empresas e produtores de leite da região de abrangência do TecnoURI. É apresentado neste artigo que o estudo de avaliação do sistema de Compost Barn (CB) utilizado por produtores de leite de cooperativas da região das Missões do Rio Grande do Sul, que se apresenta como uma alternativa promissora para a produção de leite cru, trazendo melhor qualidade e bem-estar para os animais presentes neste sistema. Esta pesquisa identifica fatores estruturais e de manuseio que interferem na qualidade das embalagens compostadas. Os dados foram

obtidos in loco, com medições de instalações, observações de rebanhos e coleta de informações técnicas sobre fazendas leiteiras. Além das variáveis consolidadas relacionadas ao manuseio e qualidade da embalagem, relata-se que a frequência de agitação, área de descanso por animal, presença de ventilação mecânica no galpão, tipo de material utilizado para compor a embalagem da cama e a a umidade relativa local são fatores que influenciam as principais variáveis de leito do sistema Composto Barn e podem ser pontos-chave para o sucesso do sistema CB em regiões subtropicais do Brasil. Este artigo apresenta os resultados do estudo de avaliação e melhoria do sistema de compostagem de cooperados produtores de leite da região das Missões do Rio Grande do Sul, visando a diminuição do CCS do leite, bem como a identificação dos microrganismos. que causam mastite. A influência do manejo na qualidade da cama é evidente, principalmente quanto à frequência de giro, correto dimensionamento da área da cama e presença de sistema de ventilação. Porém, o bom funcionamento do sistema depende em grande parte dos manejos diários adotados, que ainda precisam ser estudados para um melhor entendimento do processo de compostagem, fator chave para o sucesso na produção.

Palavras-chave: Leite, Cooperativas, Celeiro de compostagem, avaliação

1 INTRODUCTION

Milk is one of the most consumed foods, if not the most consumed by the world population. As a product of paramount importance in food, milk quality and food safety are increasingly being demanded by the world population. In view of this, it is essential for both industries and producers to increasingly produce a high quality product, which obeys the limits determined by current legislation. In the northwestern region of Rio Grande do Sul, dairy farming is one of the most used crops in agriculture, with income from a large part of farmers.

In a previous study, we developed and highlighted the application of Chemistry content that may assist in the improvement of agricultural production techniques, using rice husk ash as a molecular water reservoir for soybean production (Stracke et al 2020).

Hence the quality of milk is a constant concern for technicians and authorities linked to the health area, mainly due to the risk of spreading microorganisms related to outbreaks of foodborne diseases (Silva et al., 2002). The Support Center for the Development of Milk Products and Processes installed in the Technological Park of URI Santo Ângelo aims to provide support to companies and milk producers in the region covered by TecnoURI (URI Santo Ângelo), in order to streamline the monthly milk analysis demands of companies and make them more efficient, competitive and entrepreneurial, stimulating the growth of the local economy. Another important advisory carried out by CADEPPL is presented in this article, which is the study of the evaluation

of the Compost Barn (CB) system used by milk producers of cooperatives in the Missions region of Rio Grande do Sul, which presents itself as a promising alternative for production of raw milk, bringing better quality and well-being to the animals present in this system.

This practice of the Compost Barn system appeared in the USA around 1980, aiming to become an alternative for better handling and quality of animals that will use the compost barn, resulting in better quality and productivity of the product to be developed. The use of this technique requires daily care, such as the use of implements to revolve the bed, it is also necessary that the place be well ventilated and have sufficient size and capacity to support the adequate number of animals.

In cases of improper handling, excess moisture can occur, consequently the increase in the microbiota present in the compost bed. This microbiota can cause major problems to animals, affecting the quality and health of the herd.

According to Kolling Girardini, et al (2015), in microbiological analyzes performed in a compost barn system in the Santa Catarina region, the following microorganisms were identified: Escherichia coli, Acinetobacter sp., Alcaligenes faecalis and Bacillus sp. These bacteria have a high contaminant content and may develop mastitis in dairy cattle.

Problems like this can be solved using UV sterilization methods or pH control of the bed, as the pH decrease decreases the proliferation and controls the existing microbiota. The control method through sterilization is a new method which is still being studied and aims to help solve problems of severe mastitis, arising from environments such as the bed of the compost barn system.

The use of UV sterilization promises to remove 99.9% of the microorganisms existing in the bed at a depth of 10 cm in the period of 15 min, but the use of this method will need to put the beneficial microorganisms back into the system. For this addition of bacteria it would be necessary to develop a bacterial culture that achieves the desired goals for the system, as is done in inoculates for silage fermentation.

This article presents the results of the study of the evaluation and improvement of the compost barn system of milk-producing members of cooperatives in the Missions region of Rio Grande do Sul, aiming at decreasing the CCS of milk, as well as the diseases caused by these microorganisms. The method that will have great emphasis is that of sterilization with UV light equipment and identify the results that will appear in the bed.

2 MATERIAL AND METHODS

The present work deals with a qualitative and quantitative study, configured in a case study, in order to identify a cooperative structure and its contribution to local development, based on the perception of the social actors of cooperatives of the Missions of Rio Grande do South.

This study was characterized in relation to its objectives, as descriptive and exploratory. Descriptive, because it will be necessary to collect information using theoretical concepts about the theme, in order to identify the necessary components for the elaboration of the process. Another technique used to collect information was to visit milk producing properties and interview people who participate in the milk production system. A technical visit by UPL was carried out, always in the afternoon between 13:00 and 18:30 hours. At the time, physical and structural characteristics of the UPL, number of animals housed in the system, the animal category, racial characteristics, and the length of stay in the facility (total or partial) were surveyed. The interviews were carried out in a diversified sample in order to understand the different representations of the milk producing properties that use the compost barn system.

The nitrogen content was determined by the Kjeldahl method and the carbon content according to the EMBRAPA methodology (1997), and these values were used to determine the Carbon: Nitrogen ratio. The analyzes of dry matter, mineral matter, and pH of the bed, were performed in duplicate, according to AOAC (1990). The bed surface temperature was measured using a digital rod thermometer

The methodology used in microbiological tests to identify which microorganisms are present in compost barn bed samples was based on analyzes of microbiological samples according to Kristula et.al (2008).

The collected sample was kept in a sterile container until it arrived at the laboratory, where the plates were. The second generation chromogenic medium of the plates is able to identify the main agents that cause mastitis, by color differentiation. Chromogenic media have specific substrates that allow the growth of pathogens with different colors, thus allowing presumptive identification in 24 hours. The coloration displayed by the colonies, in turn, depends on the composition of the substrate, chromophoric substances (such as a dye) and the microorganism.

3 RESULTS

All municipalities included in the survey are located in the western region of Rio Grande do Sul. The properties were characterized by presenting an average area of 30 ± 22 hectares, which ranged from 7.6 to 130 hectares, that is, most of the ULP were small, with some exceptions. The daily managements, from milking to feeding the animals, were mostly carried out by the owners and their families, which characterizes the work of the UPL based on family labor. They had an average of 4 ± 1.6 people who assisted in the dairy activity, ranging from 2 to 6 people. The herd comprised an average of 115 ± 98 animals, with variations from 22 to 500 animals, due to encompassing some properties considered medium-sized.

In the American state of Barberg et al. (2007a) demonstrated that the main reason for adopting the CB system was to provide comfort and well-being to the housed animals. However, in the Mission region of Rio Grande do Sul, in addition to the improvement in animal welfare, among the reasons presented by producers for adopting the system, in addition to the improvement in animal welfare, the search for increased production was an expressly presented reason by the producers, and these two responses, when added up, corresponded to 82% of the total responses. Also, due to the climatic characteristics of the region, which presents well-distributed rainfall ranging from 1,500 to 2,000 mm / year (Peel et al., 2007), and the characteristics of the soil, mostly composed of clay, added to the transit of animals heavy, there is a significant formation of mud and soil degradation when the animals are exposed to the environment, which makes it difficult to carry out the daily tasks of handling the animals. Esses fatores também apresentaram influência sobre a decisão de adotar o sistema CB, com o pressuposto de facilitar os manejos diários, uma vez que, em sua maioria, são realizados por poucas pessoas.

The adoption of the CB system, as well as in other places in the world (Barberg et al., 2007a, Black et al., 2013) met the expectations of producers in relation to several aspects. All 30 interviewed producers said they were satisfied with the system. The positive points are related to sanitary, reproductive aspects and related to the handling with the system. Regarding the incidence of mastitis, 87 % of the producers reported a decrease in this disease after adopting the system, however 10 % of the producers did not observe an improvement in the occurrence of mastitis and for 3 % of the producers, the change of system in this system was indifferent question.

Bed management characteristics varied according to the routine and availability of labor in each UPL. Like the frequency of turning, which was mostly performed twice a

day, during the milking of the animals. However, in systems that still did not have a high capacity, or did not use the total confinement of the animals, they only perform a daily rotation. The equipment used to perform the revolving was called a scarifier, present in 93 % of the UPL. The turning depth was influenced by the height of the bed, in the vast majority (60%) of the UPL was carried out between 20 and 30 cm, reaching depths greater than 30 cm in 36 % of the properties.

The depth of the bed does not present exact values, however Janni et al., (2007) reported values between 30 to 50 cm, with certain variations depending on the composting process and the replacement frequency of each system. However, the authors cite that minimum depths close to 30 cm must be respected, to prevent the incorporation of soil layers during the turning process, which may interfere with the composting process. In the present study, the current depth of the bed in 50% of the systems was above 40 cm, and between 20 and 30 cm represented 30% of the systems, and it was possible to verify the presence of soil mixed with the beds of less depth.

The replacement of the beds was carried out monthly in 56 % of the properties, and in the remaining 44 % of the properties they carried out replacements between 6 and 36 months, depending on the intensity of the use of the beds and their conditions. Similar to the management adopted by American producers, described by Barberg et al., (2007a), where replacements were performed between 5 to 10 cm, between two to five weeks apart. The main parameter taken into account by the producers, in this study, to perform the bed replacements were visual and physical evaluations of the bed (AVF), a parameter adopted by 63 % of the producers.

Combining the quantitative and qualitative characteristics obtained in the present study, it is observed that approximately 77% of the owners stated that the heating process helps to dry the CB bed, and 23% are unaware of its nature and / or purpose. Furthermore, it is emphasized that in none of the properties the temperature of the bed is measured.

The average moisture content of the bed obtained in the evaluations was 57.8%, therefore within the standards cited by Nraes 54 (1992), between 40 to 65%. The average value for temperature in depth of 25 cm, before turning the bed, was 53 ° C. This is considered within the recommendations recommended by Janni et al. (2007), who reported ideal temperatures between 54 to 65ºC. Benley and Taraba (2013) also reported considerable temperature values suitable for maintaining the composting process between 43 to 60 ° C. As for the surface temperature of the bed, it presented an average value of 25 ° C close to the average internal temperature of the sheds. 28 ° C, corroborating the results

of Black et al. (2014), that the bed's surface temperature accompanies the ambient temperature.

The organic matter (OM) of the bed directly influences the carbon availability of the bed, that is, the more OM the greater the carbon availability for the microorganisms to use (Changirath et al., 2011). In the present study, mean values of 65 % were found, considered low, which may have influenced the low C: N ratio found. The C: N ratio showed modest values, with an average of 10.51: 1, lower than the 26.7: 1 ratio reported by Black et al. (2014), but close to the 15: 1 ratio reported by Janni et al. (2007). The maximum composting process occurs when this ratio is between 25 to 30: 1 (Nraes54,1992). The microorganisms present in the bed need carbon as an energy source, and nitrogen as a protein source for their metabolism, and are directly related to the stocking rate, which will determine the incorporation of feces and urine (nitrogen sources), and the frequency of replenishment of the bed (carbon source), to keep the composting process constant.

The bed pH showed an average value of 8.7, very close to the 8.45 and 8.9 reported by Janni et al., (2007) and Fávero et al., (2015). These values can be attributed to the prolonged use of the bed of the UPLs, which can cause greater incorporation of nitrogen in the medium, and an increase in the pH of the bed. According to Changirath et al. (2011), during the initial stages of decomposition, organic acids are formed, afterwards continuous composting and the acids become neutralized, and the mature compound generally has a pH between 6.0 and 8.0.

The water holding capacity (W) is directly related to the particle size, and smaller particles have a higher W, however they promote less aeration in the bed, affecting the composting process (Damasceno, 2012). Factor tested by Changirath et al. (2011), who also reported an increase in W with a decrease in particle size. In the present study, materials with an average W of 70% were found, and showed low variation, since most of the beds were composed of the same material.

The average density value found in the present study was 718.70 kg / m3, and showed variability between the UPL. Density between 372.67 and 526.17 kg / m3 were found by Fávero et al., (2015), studying three farms that used the CB system in Brazil. The density is influenced by the daily handling of the bed, which interferes in the composting process and consequently in the evaporation of moisture, and porosity of the bed. Damasceno (2012) found a lower proportion of porosity when the bulk density was high.

The particle size present in the beds presented the following average distribution: 32.7, 18.36, 16.08 and 29.05%, in the 9.75, 4.75, 2 mm sieves and the bottom portion, respectively . The particle size distribution has a great influence on the composting process, in which very large particles have a smaller specific area, and a smaller amount of carbon for the use of microorganisms (CUC, 2003). On the other hand, very small particles increase the chances of bed compaction, which can cause a lack of oxygen and affect the composting process (Nraes-54, 1992). There is a need to use materials with heterogeneous particle sizes, but with a close distribution between their particle sizes.

The evaluations of this research were carried out in December / 2020 and January and February 2021, in which a satisfactory and well-distributed rainfall was observed (data not shown). The air temperatures obtained were an average of 29.25 ° C, with a maximum of 34 ° C. These values were lower than those measured inside the CB sheds, reaching maximum values of 31 ° C, and averages of 28.44 ° C. These values demonstrate that despite the animal concentration inside the sheds, which produce heat through metabolism, added to the heat from the bed composting process, milder temperatures were obtained inside, when compared to the external environment.

The measurement of environmental parameters allowed the use of the temperature and humidity index (ITU). This indicator is the combination of the effects of humidity and temperature, in order to establish a value that represents the comfort of animals. High production cows can begin to show signs of heat stress from UTI over 68 (Zimbelman et al., 2009). Index that presented a much higher value in the present study, with an average of 77.5. This value indicates signs of stress to animals, and can cause, according to Lambertz et al. (2014) decreased dry matter intake and milk production, as well as worse reproductive performance and immune function.

For the method of the compost barn (CB) system, several microorganisms can be found, present in this environment, which can bring benefits and harms to the animals present in this environment. Some of the bacteria present in the CB system are bioremediation agents, which influence the proliferation of others through inhibition or competition, in addition to pathogenic bacteria.

Bioremediation bacteria play an important role in the bed of the compost barn, because through these microorganisms it is possible to control the pathogenicity of the medium through antagonism tests, where these microorganisms will be placed in contact with pathogenic bacteria to analyze the level of antagonism of the bacteria. bed bacteria. It can be used as a control through the use of biological processes to inhibit the bed pathogen.

In cases where the bacteria do not have the ability to control and inhibit pathogens, a UV sterilization technique may be introduced, which consists of the use of equipment with ten UV light lamps that have a sterilization capacity of 99% of the microorganisms, as this light does not destroy or damage the cellular structures of microorganisms, it just prevents their reproduction. But it is important to note that this equipment is undergoing tests to identify the real capacity that can be obtained with the use of this equipment, and tests can be carried out to identify what are the benefits and harms that it can bring.

For this to happen, microbiological tests were carried out, which aim to identify which microorganisms are present in a compost barn bed sample collected. The methodology used in this experiment was based on analyzes of microbiological samples according to Kristula et.al (2008).

The collected sample was kept in a sterile container until it arrived at the laboratory, where the plates were. The second generation chromogenic medium of the plates is able to identify the main agents that cause mastitis, by color differentiation. Chromogenic media have specific substrates that allow the growth of pathogens with different colors, thus allowing presumptive identification in 24 hours. The color displayed by the colonies depends, in turn, on the composition of the substrate, on chromophoric substances (such as a dye) and on the microorganism.

The technology has been on the market since 1990, and has been used in the diagnosis of mastitis, especially in the last 6 years. Scientific studies (Granja et al., 2019) have demonstrated high accuracy of chromogenic and selective culture media for the identification of: S. aureus, SNA, Strep. uberis, Strep. agalactiae / dysgalactiae, Enterococcus, Lactococcus, E-coli, Pseudomonas, Klebsiella / Enterobater, Prototeca and yeast. Therefore, the use of chromogenic means allows the identification of the main bacteria that cause mastitis in the bed of the farm compost barn in 24 hours, in a safe and easy to interpret manner.

The group of bacteria classified as non-aureus Staphylococcus (ANS), also known as coagulase negative Staphylococcus (SCN), are pathogens of the Staphylococcus genus, which have a high prevalence in cases of mastitis. These pathogens mainly inhabit the skin and the roof channel. The main pathogen classified as ANS found isolated in milk samples with mastitis is Staphylococcus chromogenes, it, like the other species in this group, has different origins, associated with the cow or the environment.

Infections caused by these pathogens have a low impact, with little change in milk production and composition, and may present an increase in somatic cell count (CCS). A

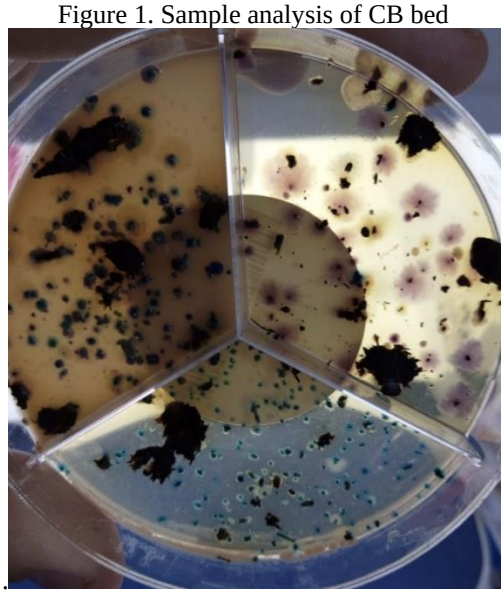
study carried out with 21 dairy herds, with the objective of identifying changes in production, CCS and milk composition in subclinical infections by ANS, showed that only the change in CCS is significant, with no change in relation to the production and composition of the milk of the animals evaluated (TOMAZI et al., 2015).

Infections by these agents can occur during the prepartum period or during lactation. It is extremely important to maintain hygiene in the facilities where the cows are located, mainly avoiding the accumulation of organic matter, as well as the correct hygiene of the milking sets.

SNA respond very well to antimicrobial treatments (cure in 80 to 90% of cases), however cows with more lactations are less likely to cure. Treatment is indicated in cases of moderate and severe CM, as well as in cases of persistent mastitis caused by these pathogens. In addition, these pathogens have high rates of spontaneous cure, without the use of any treatment, especially in mild cases of clinical mastitis and cases of subclinical mastitis in primiparous women.

As a result, we identified the following bacteria: Staphylococcus non-aureus (left side of the plate, bacteria of different colors of pink that would be characteristic of S. aureus), Streptococcus uberis (bacteria with a blue color), Escherichia coli (pink-colored bacteria) of the Compost Barn beds, as shown in Figure 1.

Figure 1. Sample analysis of CB bed



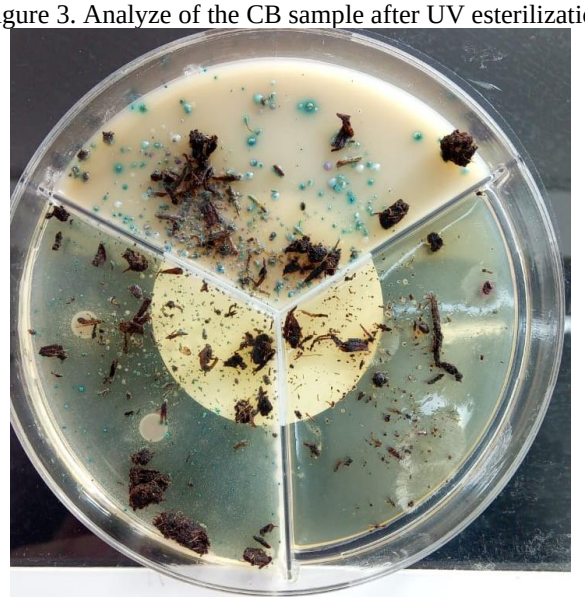
To prove the validation of the results, microbiological samples were analyzed according to Kristula et.al (2008). The collected sample was kept in a sterile container until arrival at the laboratory, where 20g of the sample was added to 180g of sterile purified

water, then mixed and left to rest. After 40 min the sample was added to the plates, with differences of 0.1 and 1 ml. As a result, we confirmed the identification of the following bacteria previously found: Staphylococcus non aureus, Streptococcus uberis, Escherichia coli from the compost barn bed sample. From these results, a sterilization was performed with a 300W UV light device with 10 lamps for 20 seconds, with the stored bed material that was not used in the previous analysis, as shown in Figure 2.

Figure 2. Uv sterelization of CB sample.

After using this equipment, a new plating was performed so that it was possible to observe which microorganisms would remain present after sterilization. The bacteria that were resistant were: Streptococcus uberis, and Escherichia coli (with negligible incidence), according to the plate in Figure 3.

Figure 3. Analyze of the CB sample after UV esterilization



The method proved to be highly effective in sterilizing E. Coli from cow beds in the Compost Barn system. As for S. Uberis, a small reduction was observed, according to the plate in Figure 3. The results indicate that the use of this UV sterilization methodology would be applied with 99.9% efficiency in the control of bacteria in the beds of the Compost Barn system of the work of Kolling Girardini, et al (2015).

4 CONCLUSIONS

After checking and comparing all the results obtained in the analyzes, it is clear that most producers have CCS or CPP greater than the allowed value, thus, it is understood that there is a general problem.

Thus, it can be concluded that there is a resistance on the part of producers regarding the appropriate and allowed way that the cow's milk must be collected as well as the way of cleaning the animal and the equipment used.

In addition, it must be considered that the milk needs to be kept at a temperature of 4ºC, both at the producer's location and also during the journey made by the truck to the cooperative. However, few producers have adequate cooling of the milk on their property, so if the cooling is not carried out properly, it causes the CCS and CPP value to increase.

The influence of management on the quality of the bed is evident, mainly regarding the frequency of turning, correct dimensioning of the bed area, and the presence of a ventilation system. The systems that obey these requirements, present, in their majority, the bed within the recommended standards for the maintenance of the composting process. However, the adoption of CB has met the expectations of producers, with improvements in issues of production, comfort and animal and human well-being. However, the good functioning of the system depends to a large extent on the adopted daily managements, which still need to be studied for a better understanding of the composting process, a key factor for success in production.

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