Development of a preservative for moist hay to extend the hay baling window

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Introduction It is becoming increasingly difficult to produce high-quality hay, because the hay rarely dries evenly on the field. Especially high mass coverage and unstable weather conditions make it almost impossible to uniformly dry to higher than 85 % dry matter. Often it is the stem nodes that are not sufficiently dry. After harvesting, residual moisture returns to the stems and leaves. This benefits certain microorganisms, especially moulds. Their growth reduces quality and feed hygiene. External signs of microbial activity include the rise in the temperature in the stored hay. In order to counteract such spoilage processes, the use of preservatives is gaining increasing attention. As a rule, products based on propionic acid are used for this purpose. However, their use is not entirely unproblematic. In addition to relatively high application rates, the risk of corrosion in the recovery technology, the need for a special acid-resistant dosing technology and transport restrictions on possible application restrictions make its use difficult. The aim of the investigations was therefore to develop a user-friendly alternative product based on neutral salts to the classic acid-based products.

Materials and Methods: In the laboratory trial the relation between heating and microbial development and biochemical changes were studied. For this trial German Grazing Grass *(Lolium perenne)* was harvested in 2015, dried and pressed into 25 kg square bales as moist hay. The target value for the residual moisture was 22 %. In addition to the untreated control (T1), the moist hay was treated with a special formulation of three anti-fungal chemicals (T3) (potassium sorbate, sodium benzoate and sodium propionate, produced by Danstar Ferment (Zug, Switzerland) with different individual modes of action. This salt mixture was applied at 250 g / t, solved in 1 litre water. Propionic acid (T2) (99.8 %, 4.5 l / t) was used for positive control. The moist hay was examined at the beginning of each test (Table 1, composite sample) and after 30 and 100 days of storage (sampling of 5 individual bales). During storage, the temperature development in the bales was recorded by means of a data logger. As the bales were stored, in such a way that the formed heat could escape easily, a temperature of 45 ° C was never exceeded. Furthermore, individual bales (n=5) of each treatment were examined after 30 and 100 days of storage and the dry matter content, feed value and hygiene status were determined.

Table 1 Nutritional and microbial parameters of grass prior to baling

Parameter	Unit	Value
Dry matter	% FM[1]	78.0
Crude ash	% DM[2]	9.7
Crude protein	% DM	8.3
Crude fibre	% DM	28.2
Neutral detergent fibre	% DM	58.1
Acid detergent fibre	% DM	29.8
Lactic acid bacteria	Log CFU[3]/g FM	4.67
Yeasts	Log CFU/g FM	5.86
Moulds	Log CFU/g FM	6.18
Enterobacteria	Log CFU/g FM	4.96

[1] – Fresh material, [2] – Dry matter, [3] – Colony-forming unit

Results and discussion: Raw material (Table 1): The target residual moisture content of 22 % was achieved. With regard to the hygiene status (mould count) the values, according to the VDLUFA-

orientation values of 1.500.000 CFU / g were achieved. **Temperature development (Figure 1):** During storage, there is a distinct warming in the untreated control, which was a clear indication of microbial spoilage processes. On the other hand, no increase in temperature was observed in all the replicates of moist hay treated with preservatives. **Hygiene status (Table 2):** Microbial spoilage quickly began in the untreated control. The mould count remained unchanged and high (after 30 days log 5,90 or after 100 days log 5,60 CFU / g). In contrast, the number of moulds found in both preserved varieties decreased, with the largest decrease in the neutral salts mixture variant, with 100 days of storage; the number of moulds decreased here to log 4,65 CFU / g. **DM-content and further parameters (Table 2):** Compared to untreated control, all preservative treated bales had a better feed value and higher energy densities. Thus, the digestibility of the organic matter in the bales, preserved with the new formulation, was 2.1 % higher than the control, and the net energy was 0.12 MJ NEL / kg DM higher. Spoilage and loss of nutrients could be safely avoided. As expected, there was a further increase in dry matter content in the bales stored during the entire storage period.

Figure 1 Bale temperature profile (5 replicates)

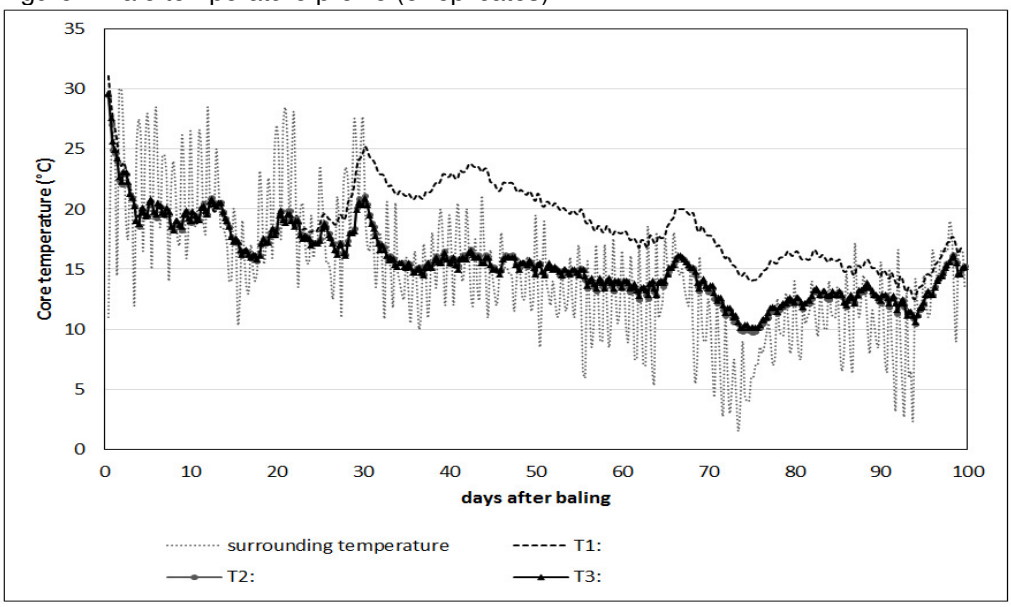

Table 2 Cumulative temperature, hygiene status and nutritional value after 30 and 100 days of storage (5 replicates) (P<0,05)

	Cumulative temperature °C	Moulds Log CFU / g FM	DM %	dOS[1] %	NEL MJ/kg DM
30 days storage					
T1	2422 ± 62	5,90	83,1	60,3	4,57
T2	2223 ± 54	5,13	85,4	61,1	4,61
T3	2242 ± 66	5,62	85,0	63,7	4,75
100 days storage					
T1	7458 ± 198	5,60	84,0	60,1	4,54
T2	6134 ± 40	4,85	84,2	60,8	4,59
T3	6168 ± 22	4,65	84,1	62,2	4,66

[1] – Digestibility of organic matter

Conclusions With the help of preservatives, moist hay can be stored safely and loss-free. Heating and spoilage are prevented and quality is ensured. With the new product formulation based on neutral salts, a user-friendly alternative to the acid-based preservatives for moist hay is now available.