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THE CONNECTION BETWEEN STORAGE AND QUALITY OF MEADOW HAY

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ABSTRACT
The practical application of hay quality is of particular importance in Hungarian beef cattle and horse farming. Due to the high price of protein and supplementary feeds on the international market, it may be a worthwhile alternative to base the demand for feedstuffs exclusively on high feed value meadow hay. To do this, it is necessary to be aware of the daily variation in quality and quantity. Following the good practice guidelines both livestock farming and product marketing can be planned. Our recommended solution is focusing on quality reservation. The presented technology (ventilation, dry floor, large air space) guarantee the conservation of the genuinely high value hay. Strict protocol must be applied (mowing at the right time with conditioner, forage sampling for digestible fibre content). After stacking, bale temperature increases during the first 5 days up to 41°C. Then the next 8 days a stagnant trend is seen. At the final stage, core temperature stabilizes at 30°C. Preventing caramelization and hay stack fires are priorities for every farmer.

Keywords: core temperature; hay storage; digestible fibre; rumen passage; stack fire

INTRODUCTION

When you hear the word hay, most farmers think of alfalfa hay. That's probably because alfalfa hay is our best-known, most commonly produced legume crop. According to the National Statistics (NET 1), 200 000 hectares were under alfalfa cultivation in 2019. It is easy to incorporate into crop rotation and can be counted as an ecological focus area as a nitrogen-fixing crop as part of compulsory greening. If the farmer uses certified seed and applies the prescribed amount of seed when sowing, he is also entitled to an additional fibre protein crop premium. For alfalfa, the average yield is 5 T ha^{-1}, while for grassland it is 1-2 T ha^{-1} in dry, arid areas. Its production and harvesting require a complex technological line, but it has a marketable price range, even on export (HALASZ, 2020). No question about protein side nutritional value of alfalfa hay but the digestible fibre and mineral content of grass is more nuanced (*Table 1*).

Table 1: Comparison of nutrient content of hay and alfalfa (BUCHGRABER ET AL., 1998)

	Alfalfa	Meadow hay
Protein (g/kg)	224	115
Fat (g/kg)	18	22
Fibre (g/kg)	241	294
Calcium (g/kg)	18,3	5,2
Phosphorus (g/kg)	2,9	2,9
Dry matter (g/kg)	876	880

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Alfalfa provides good feed for animals as it has a high protein content, but once in the rumen, legumes are much more fragile than grasses and therefore their digestibility (+15-20% faster degradation within 24 hours) is overall slower than grasses (*Figure 1*). This is the real advantage of meadow hay, as the breakdown of alfalfa in the rumen is 30-40% worse due to its higher lignin content. The two degradation curves intersect between 24-30 hours. Beyond this point, grass fibre degradation is more favourable (OROSZ, 2015).

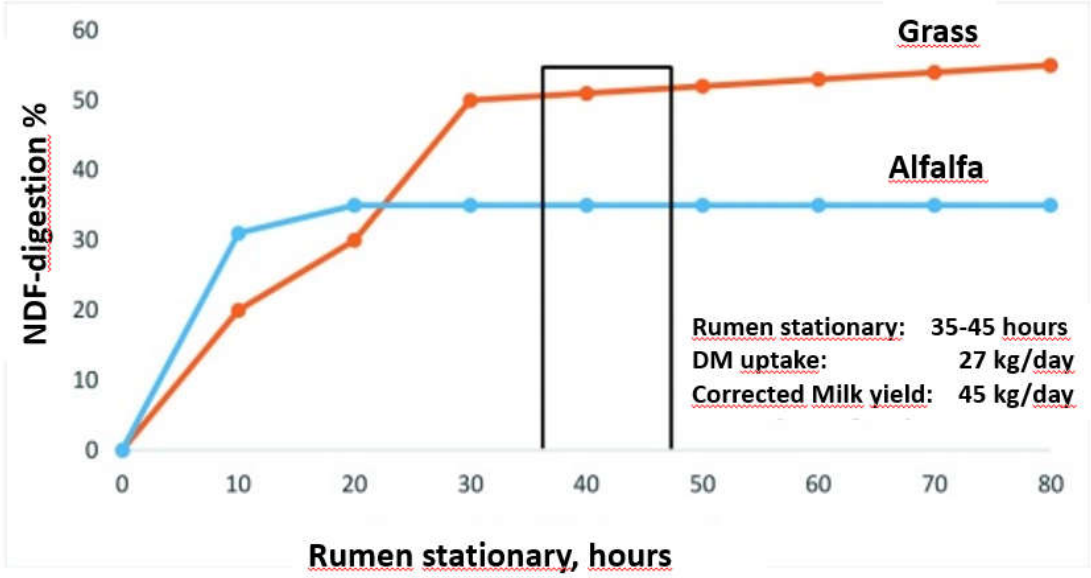

Figure 1: Grass and Alfalfa digestion in rumen (Source: GRANT, 2015)

Grasses fill the rumen more, thus slowing down the outflow (rumen passage rate). The longer rumination time allows more nutrients to be digested and the hard fibres of grasses mean that a smaller amount of meadow hay is sufficient to achieve the same activity. Leaf retention is not an issue in meadow hay production and can be harvested during the day (OROSZ, 2017).

HAY AGROTECH

Producing the right quality feed starts with mowing. The drying time of the hay is greatly reduced by the use of mechanical conditioner, which makes it easier for the plant to shed water by crushing stalks and split leaves. There are two types of conditioners. The flail type design, used more for grasses, and the rubber roller design is preferred for legumes. The flail conditioner cuts the whole plant lengthwise, while the roller crushes the stem to speed up drying. Mower-conditioners need 15-20 horsepower more traction and significantly more expensive than simpler mowers. For this reason, small scale farmers cannot afford this tool.

After mowing, it is advisable to rake the swath to allow it to dry as soon as possible. This can be done with a rotary rake. Correct adjustment is extremely important, as an incorrectly adjusted machine can contaminate the forage with soil increasing ash content.

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The swath merger also requires great care, as the wrong setting can leave a lot of feed on the ground or elevated amount of soil contaminates the forage.

Baling is the last operation, which requires the most attention. If it is done too early, the hay may be too wet, but if it is done too late, it will be too dry and the vitamins, minerals will be lost from the forage. Proper compactness is also important as post-drying taking place for days.

MATERIAL & METHODS

We gathered bale core-temperature and humidity data and compared with ambient temperature and humidity in enclosed hay barn. The measurements were carried out in Piliny village (Nograd-county, North Hungary), on a livestock farm. The hay-barn formerly used as a sheepfold for winter feed storage, which was closed and insulated on all sides.

Hay bales transported straight to the barn almost immediately after baling. The building was used as a sheepfold, but has lost this function due to a lack of sheep. There are 4 ventilation doors on one side and an entrance at both ends. The floor is covered with sand and straw before loading. Moisture is moving upwards from the ground therefore straw bedding is a perfect insulator. Ventilation is also important, creating adequate draft with crosswise opened vents and doors. The size of the facility is 60 m x 12 m x 5,5 m, with approx. 4000 m^3 airspace. The storage barn capacity is 870 round bales (150Ø x 120W cm). On one side of the storage section there is a safety path to control the entire length of the hay stack.

In practice, core temperature is checked with a reinforcing bar right before transport. The rebar is inserted into the middle of the bale, where fermentation heating is most likely to start. The daily rebar temp check is a perfect monitoring method. In case of serious heat up there is still chance to remove couple of bales. The evaporating moisture changes ambient temperature and humidity which is measured 3 different height. Data was monitored for 21 days in 45 cm depth. Humidity was measured with a temperature and humidity meter. 4 bales were measured daily (± 5% SD) at 4:00 pm.

RESULTS

Initially bale core temperature is rising, peaking at 41°C on Day 5. Then a stagnant stage follows for another 8 days. During this period bale evaporated any remaining moisture, and then settled to a constant temperature of 30°C. After 21 days the drying process halts. Overall, the humidity followed the variation of the bale temperature. The highest values were on Day 5 and 9 (*Figure 2*.).

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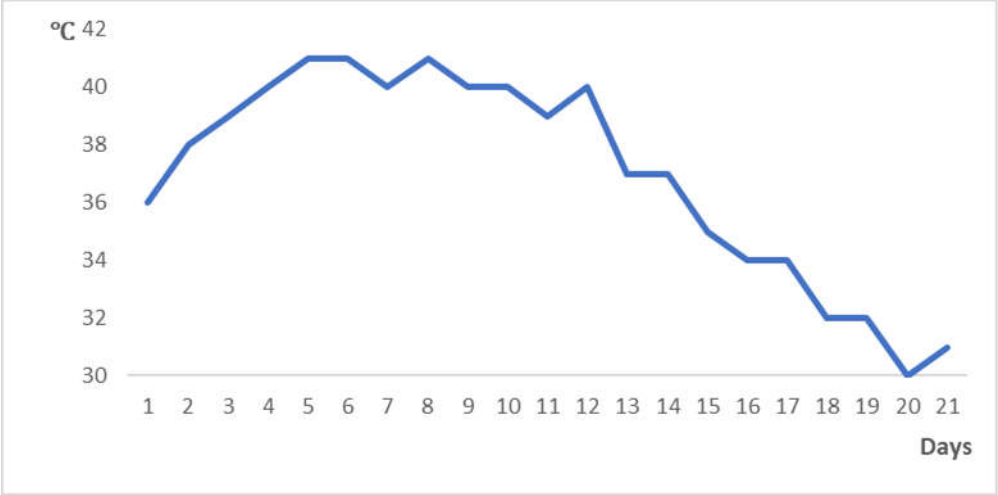

Figure 2: Bale core temperature on the first 21 days**.**
(4 marked bales/day)

DISCUSSION

Hay quality largely depends from species composition, water- and nitrogen supply. Dicots and C_4 grasses significantly increase fibre content (HALASZ ET AL., 2021). Higher crude protein content is associated with faster drying time (OROSZ & MEZES, 2007). Therefore, high protein in leaves, inevitably sticks with moist stems, which is a straightforward formula to apply mower conditioner. The quicker dries your leafy hay, more valuable protein You save (COBLENTZ ET AL., 2004). Despite proper hay management (TOTH, 2011), quality issues are still not a priority. Climate change and growing fertilizer prices drag in the quantitative issues. In daily practice the "*How many bales You got?*" is still more important than "*How much did it cost?*" and "*How much supplements You saved?*".

CONCLUSIONS

Hay making does not end with storage. Bales continue to breathe and release water for weeks. Improper work and timing will degrade the hay quality and could lead to stack-fire. During our field test there was no extreme heating (danger zone 55 °C), bales did not heat up more than 41°C. Lower core temperature means less nutrient loss and caramelization.

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