Fermentation potential and nutritional value of Virginia mallow and its usefulness in the nutrition of ruminants

Abstract

The aim of this doctoral thesis was to determine the possibility of ensilaging the biomass of Virginia fanpetals through the selection of optimal additives and harvesting technology, as well as to determine the nutritional value of Virginia fanpetals silages in the nutrition of ruminants and the assessment of their use in cattle nutrition. It has been hypothesized that the Virginia mallow can be an alternative source of valuable roughage for fattening cattle and dairy cows.

The doctoral thesis consists of four feeding experiments. In *experiment I* (Starczewski et al., 2020), the effect of various additives (straw, grass, molasses, dried sugar beet pulp pellets, bacterial inoculant, organic acid) on the quality and fermentation profile of Virginia fanpetals silage based on its chemical composition and fermentation parameters were compared, and also the apparent digestibility of the silage in sheep was assessed. In *experiment II* (Purwin et al., 2021), different harvesting (fresh or wilting) and preservation (silage in heaps or bales) methods of Virginia fanpetals on the quality parameters, intake and digestibility of silage, and the performance of growing bulls was evaluated. *Experiment III* relied on the assessment to which extent of Virginia fanpetals silage affect the carcass and beef quality characteristics. In *experiment IV* (Purwin et al., 2020) the forage value of Virginia fanpetals silage for dairy cows was assessed, as well as its impact on milk yield and physicochemical properties of animals.

Experiment I has shown that the tested additives increased DM, decreased ADL content, and reduced WSC utilization in silages. Only sugar beet pulp decreased the content of NDF and ADF. All silages had similar pH values and were characterized by intense lactic acid fermentation, which was inhibited only by the grass additive. All additives suppressed acetic acid fermentation. Grass and sugar beet pulp significantly decreased the concentration of butyric acid and increased the coefficient of NDF digestibility. Contrary to the addition of grass, which decreased CP digestibility, the addition of a bacterial inoculant and a blend of organic acids increased CP digestibility and also decreased NDF digestibility. In *experiment II*, it has been demonstrated that harvesting methods affected the density and WSC content. It has also been shown

that ensilage of withered green forage in bales increases the digestibility of organic matter and protein, but reduces dry matter intake and weight gain. The withered forage ensiled in the heap increased all the above indicators in comparison with the control group. *Experiment III* has shown that silage type had no significant effect on BWG or feed to gain ratio. The carcasses of bulls fed Virginia fanpetals silage and maize silage received higher scores for conformation than the carcasses of bulls fed grass silage. The meat of bulls fed Virginia fanpetals silage had the lowest value of Warner-Bratzler shear force, whereas meat of bulls fed Virginia fanpetals silage and maize silage had the highest intramuscular fat content and was lightest in color. Meat from bulls fed Virginia fanpetals silage and grass silage received the highest scores for color uniformity, aroma, taste and overall acceptability. In *experiment IV,* it has been demonstrated that complete substitution of alfalfa silage with Virginia fanpetals silage caused an increase in dry matter intake, total volatile fatty acids, acetic acid to propionic acid ratio, N-NH3 in the rumen contents and milk urea and a decrease in the feed conversion ratio. The partial and complete substitution of alfalfa silage with Virginia fanpetals silage changed the profile of milk fatty acids, resulting in increase in saturated fatty acids and a decrease in unsaturated fatty acids as well as in all functional fatty acids except vaccenic acid. The most promising production effects were achieved through partial substitution of alfalfa silage with the Virginia fanpetals silage.

This dissertation provided evidences to state that the green biomass from Virginia fanpetals is a good material for ensilage, and the resulting silage is characterized by interesting chemical composition, good fermentation profile and good apparent digestibility. Moreover, the obtained results indicate that the Silage of Virginia mallow is a good source of protein and can be successfully part of the ration in the nutrition of young bulls, cattle for fattening and dairy cows.