



Prunings in fruit species, source of food reserve for beef cattle breeding

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ABSTRACT. Summer pruning of fruit species as an alternative for feeding with vegetable waste in beef cattle breeding is observed. The experiment was conducted in 2020 in an experimental farm for beef cows (Hornless Hereford breed) of the Research Institute of Mountain Stockbreeding and Agriculture, Troyan (Bulgaria). The animals were fed in a controlled manner with standardized amounts of foliar fodder, obtained after summer pruning of fruit crops (plums, apples, pears). The main purpose of the study is to consider the potential and opportunity of using plant matter after summer pruning (green pruning) in various orchards, as a food reserve in beef cattle breeding. The highest appetite was shown by the leaves and twigs obtained during plum pruning (combined group of two cultivars) (46.6%), followed by those of the apple (31.2%) and the lowest value was registered for pear species (22.2%). The total amount of the three types of fodder is accepted as 100%. Compared to the other studied species, the foliar fodder from *Prunus domestica* had the highest content of crude protein (20.3%), minerals (11.7%), calcium (2.2%), phosphorus (0.6%) and nitrogen (3.2%).

Keywords: prunings, foliar fodder, nutritional value, appetite, bulls.

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Introduction

In recent years, the issue of creating innovative approaches and strategies aimed at more efficient use of residual derivatives in the agricultural industry has been worked on worldwide (Georgiev, 2013; Santana-Meridas, González-Coloma, Sánchez-Vioque, 2012). Many of these residues are valuable energy raw materials for the production of renewable 'green' energy (Voca et al., 2016).

A high percentage of residual biomass is obtained as a result of agrotechnical events (pruning) in the cultivation of fruit and vineyards (Dyjakon & García-Galindo, 2019), food production (Espinoza-Tellez et al., 2020) and others.

Depending on the type of pruning operations performed (winter or summer), the question arises for a more complete utilization of the removed branches and shoots. According to Bilandzija, Voca, Kricka, Matin & Jurisic (2012), the cut biomass as a result of winter pruning has a higher energy potential and is a suitable starting material in bioenergy production (Scarlat, Blujdea, & Dallemard, 2011).

The application of summer pruning operations, expressed in the selective removal of leaf area during the vegetation (Nikolova, 2012) have the potential to be used as an alternative fodder food reserve for feeding farm animals (Temel & Pehlivan, 2015). This, in turn, favours the development of a circular economy, following the principle of using waste as a raw material (Mirabella, Castellani, & Sala, 2014) in certain areas. In this sense, in the livestock sector, during the autumn-winter period, hay from natural meadows and pastures is one of the main sources of food for ruminants (Temel & Sahin, 2011).

Reduced volume or poor quality of dry fodder mass affects the health and limits the productivity of farm animals (Oktay & Temel, 2015).

Therefore, in recent years, a number of scientists (Nahand et al., 2011; Gulumser & Acar, 2012) point to the use of foliar fodder (from shrubs and trees), the nutritional value of which depends on the tree species and development phase, as an alternative source of conventional forage crops (Ghazanfar, Latif, Mirza, & Nadeem, 2011).

The chemical composition of foliar fodder consists of the organic substances, such as lignin, cellulose, proteins, fats, waxes and resins (Brezin, Antov & Kovacheva, 2013). Organic substances are also present in

insignificant quantities: starch, sugars, proteins and pigments, composed of four chemical elements - carbon, hydrogen, oxygen and nitrogen. It was found that in peach leaves, the content of CP is 117.57 g kg⁻¹, and the leaf mass of plum, apple, poplar and mulberry has a high cellular (NDF, ADF, ADL) content (Temel & Pehlivan, 2015). The energy value and mineral composition of the dry matter determine the economic importance of foliar fodder.

The main purpose of the present study is to consider the potential and opportunity of using plant matter after summer pruning (green pruning) in various orchards, as a food reserve in beef cattle breeding. Estimation of the nutritional value of the obtained foliar fodder. Determining the appetite of farm animals in relation to different experimental fruit crops.

Material and methods

The experiment was conducted in 2020 at the Research Institute of Mountain Stockbreeding and Agriculture in Troyan. In the experimental farm for beef cows (Hornless Hereford), the animals were fed in a controlled way with foliar fodder, obtained after summer pruning of fruit crops (plums, apples, pears). The appetite of the feed was monitored and determined by the method of "nursery cafeteria" Gillet, Noel, and Jadas-Hecart (1983). Appetite was determined by the amount of fodder consumed (taken as 100% of the animal's diet during the first 10-15 minutes). The most appetizing was the one with the highest consumption (Todorov, Krachunov, Dzhuvinov & Alexandrov, 2007).

Summer pruning was carried out during the period (May-June), consisting of the removal of gills/лакомци and branches that contribute to shading inside the crowns. It usually achieves to a large extent the formation of the structure of the trees for the next year.

The chemical composition of the dried and ground leaf matter of fruit crops includes analysis of: Crude fiber (CF, %) by Weende analysis - the sample is treated sequentially with solutions of 1.25% H₂SO₄ and 1.25% NaOH; Crude protein (CP, %) according to Kjeldahl (according to BDS / ISO-5983); Crude fat (Cft, %) by extraction in a Soxhlet type extractor and drying in a laboratory dryer at 95°C to constant weight (according to BDS / ISO-6492); Ash (minerals, %) - gradual combustion of the sample in a muffle furnace at 550°C (according to BDS / ISO-5984); Dry matter (DM, %) - empirically calculated from % moisture; Calcium (Ca, %) - Stotz - complexometric; Phosphorus (P,%) - with vanadate-molybdate reactive according - spectrophotometer (Agilent 8453 UV - visible Spectroscopy System) measuring in the area of 425 nm and Nitrogen-free extractable substances (NFE, %) = 100 - (CP, % + CF, % + Cft, % + Ash, % + Moisture, %).

The fiber composition of cell walls was determined by the method of Van Soest and Robertson (1979) and includes: Neutral Detergent Fibers (NDF, %), Acid detergent fibers (ADF, %) and Acid detergent lignin (ADL, %). Empirically calculated are: Hemicellulose (%) = NDF - ADF and Cellulose (%) = ADF - ADL. The degree of lignification is expressed as a percentage ratio (ADL / NDF) * 100 (Akin & Chesson, 1990).

Statistical analysis

For statistical data processing were used software products *Analysis Toolpak for Microsoft Excel 2010* and *STATSOFT Statistics for Windows 10*.

Results and discussion

Carrying out summer pruning of fruit species is an agrotechnical measure that contributes to the lightening of the crowns of fruit trees, thinning of the knots, leads to weakening of the growth (vegetative) potential of species and cultivars that require a smaller volume of vegetative mass. The use of fallen wood with the leaf mass on it as animal feed is an alternative method for waste-free technology when performing summer pruning of fruit trees. The utilization of the natural resources presented by the conducted research shows a very good symbiosis in the maintenance of orchards with the livestock farms.

Appetite is a relative value that accumulates all feed qualities related to the intake and nutritional composition of fodders (Kirilov, Stoycheva, & Vasileva, 2016). Experimental cattle were granted free simultaneous access to three equal quantities of the tested foliar fodder. The results for appetite of the three fruit species are given in Figure 1. The leaves and twigs, obtained during the pruning of plums (combined group of two cultivars) 46.6%, showed the highest degree of appetite, followed by apple (31.2%) and pear

plant material showed the lowest value (22.2%). The total amount of the three types of fodder is accepted as 100%. The share of each fodder from the total amount was calculated by the eaten fodder of each species.

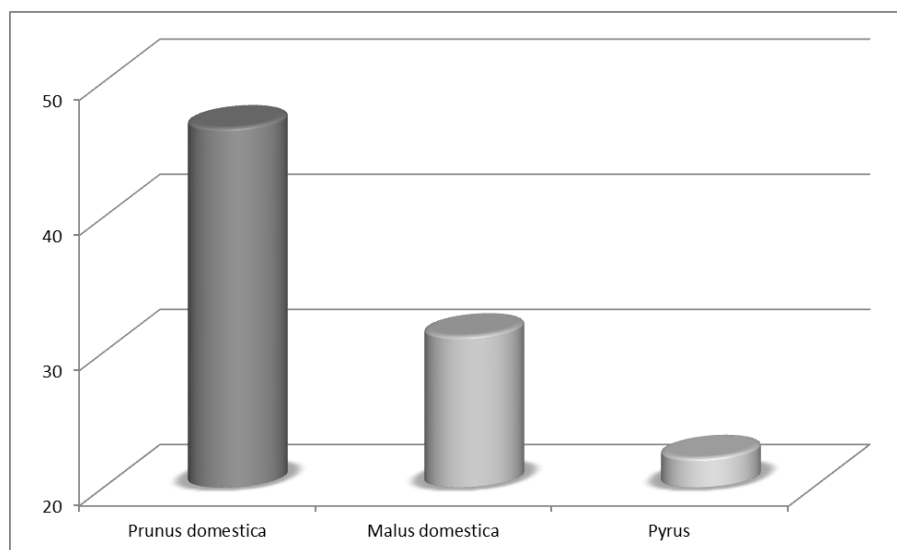


Figure 1. Appetite of foliar fodder of fruit species (% of total consumption).

The amount of fodder consumed during the first 15 minutes of feeding determines the appetite of each species tested. The obtained values for appetite are relative values for the studied species, which give a general idea of their feed qualities.

The provision of unconventional feed resources can be an effective measure for feeding farm animals (Wadhwa, Bakshi, & Makkar, 2015). According to Sahoo, Ogra, Sood, and Ahuja (2010), the amount of essential macronutrients is important for the normal course of life processes (especially for young adolescents), as the leaf mass is highly digestible and high in nitrogen. Compared to the other studied species, the foliar fodder from *Prunus domestica* has the highest content of crude protein (20.3%), minerals (11.7%), calcium (2.2%), phosphorus (0.6%) and nitrogen (3.2%) – Table 1.

Table 1. Chemical composition (% in DM) of dry matter of foliar fodder of fruit species.

Foliar fodder	DM	CP	CF	Cft	Ash	NFE	Ca	P	N
<i>Prunus domestica</i>	89.9	20.3	14.6	4.9	11.7	38.4	2.2	0.6	3.2
<i>Malus domestica</i>	90.0	13.2	14.0	9.1	9.1	44.5	1.7	0.5	2.1
<i>Pyrus</i>	89.5	11.2	21.9	7.5	6.9	42.0	1.9	0.3	1.8

Dry leaf mass of genus *Pyrus* had the highest concentration of crude fiber (21.9%). The leaves of the fruit species had the lowest content of phosphorus (0.3%), nitrogen (1.8%), minerals (6.9%) and protein (11.2%).

The maximum values of dry matter (90.0%) was registered in apple fruit species (*Malus domestica*), followed by those of plums (89.9%) and pears (89.5%). Apple leaf mass had the highest content of crude fat (9.1%) and nitrogen-free extracts (44.5%), but with the lowest amount of calcium (1.7%).

The content of fiber structural components in the cell walls is essential for the uptake and digestibility of feed, as well as for the productivity of farm animals (Churkova, 2012; Naidenova & Vasileva, 2016). The analysis of the studied data shows that the dry leaf mass of plum fruit species had the lowest values of the indicators: NDF (23.1%), ADF (12.2%), ADL (6.0%) and cellulose (6.2%) – Figure 2.

The dry matter obtained after pruning of trees of genus *Pyrus* registered the highest concentration of neutral and acid-detergent fibers (36.6 and 22.3%), acid-detergent lignin (12.6%) and cellulose (9.7). Pear had the highest concentration of polyoside in its dry matter, like hemicellulose (14.2%), which is fully digestible by animals,

The lower degree of lignification is the result of a lower concentration of NDF in the cell walls. The leaf mass of *Prunus domestica* (Figure 3) showed the lowest degree of lignification (25.8). The values for *Pyrus* and *Malus domestica* exceeded the values of the indicator by 31.0 and 44.6%, respectively.

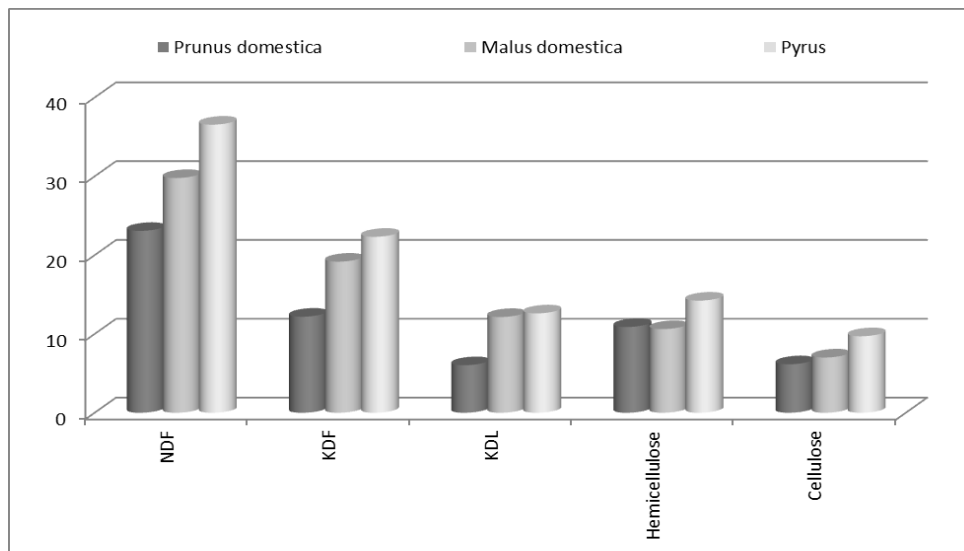


Figure 2. Structural fiber components (% in DM) in dry leaf matter of fruit species.

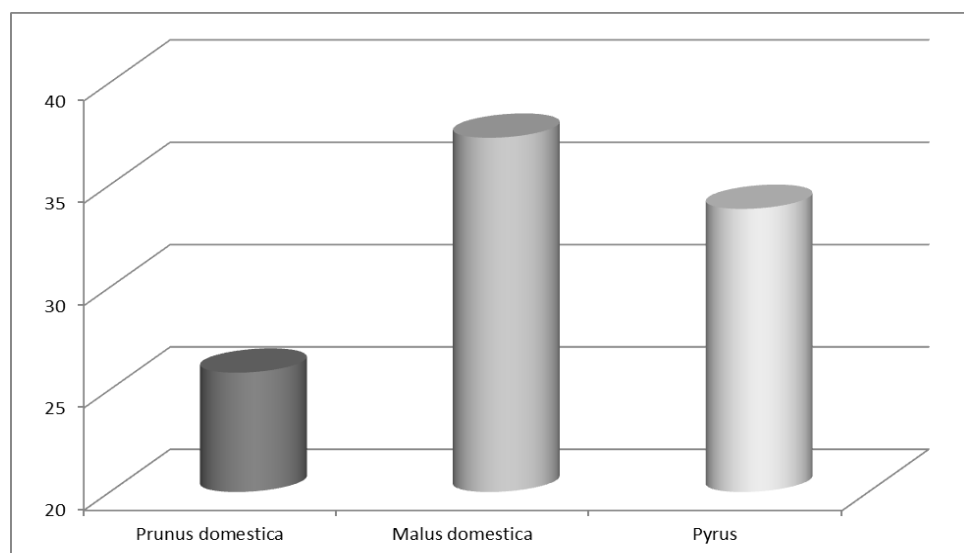


Figure 3. Degree of lignification of foliar fodder from fruit species (coefficient).

Conclusion

Summer pruning is an alternative source of feed for beef cattle in a period when there are not enough other feed sources in the mountain regions of Bulgaria. It is a specific process contributing to the creation of technology for waste-free summer pruning, which maximizes the utilization of waste leaf mass for feeding in livestock farms.

The highest degree of appetite was registered for the leaves and twigs from plum pruning (combined group of two cultivars) - 46.6%, followed by those of the apple - 31.2% and the lowest value was registered for pear species - 22.2%. The total amount of the three types of fodder is accepted as 100%. Compared to the other studied species, the leaf fodder from *Prunus domestica* had the highest content of crude protein (20.3%), minerals (11.7%), calcium (2.2%), phosphorus (0.6%) and nitrogen (3.2%).

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