Nutritive Evaluation of Mulberry Leaves Based Apple Pomace Silage

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Key words: Nutritive; silage; apple pomace; mulberry.

Abstract

The present study was conducted to evaluate the nutritive value of mulberry leaves based apple pomace silage in Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India. In the study, the silage was prepared by mixing of maize, apple pomace (AP) and mulberry leaves in ratios of 80:10:10 (T1), 70:20:10(T2) and 60:30:10 (T3), and mixing of apple pomace with wheat straw in the ratio of 85:15(T4), and the silage prepared by using 100 per cent chopped maize was taken as control. Silage bags were opened after a period of three months and the proportionate samples were drawn for nutritive analysis. The nutritive analysis of the silage samples revealed that the nutritional composition varied significantly on inclusion of apple pomace at 10, 20 and 30 per cent levels.

Inclusion of apple pomace to the silage at 10% (T1) resulted in comparatively better nutritive parameters than recorded in T2, T3 and T4. The inclusion of apple pomace increased the silage CP in T1 (8.73%), T2 (8.37) and T3 (8.83%) compared to maize silage alone control (7.35%). The inclusion of apple pomace at 10, 20 and 30 % in T1, T2 and T3 respectively reduced the CF content to 25.67%, 22.72% and 21.53 % while the control had a CF content of 26.36%. AIA content decreased with the increase in the apple pomace content to 10, 20 and 30% in T1 (1.55%), T2 (1.35%) and T3 (1.25%) although the control with 100% maize silage was recorded to have the lowest AIA content with 1.04% suggesting that the silage was more digestible and high in minerals. Increasing apple pomace content in the silage at 10, 20 and 30 per cent resulted in the significant decrease in the pH, DM, CP, EE, CF, NDF, ADF, TA and AIA. The inclusion of apple pomace at 10% can be successively utilized in animal feeding for obtaining optimum yield and production.

Introduction

India is an agricultural country with nearly 70 per cent of the population living in rural areas and rely on agriculture and its allied sectors for their sustenance and accounts for 28.4 per cent of the total GDP of the country (Anonymous, 2020). The major constraint in animal production in the country is low green fodder availability in resource-poor rural areas and the reasons for shortage of feed and fodder are the increasing pressure on land for growing food grains, oil seeds and pulses while minimal attention has been paid to the production of fodder crops.

Apple (*Malus domestica* Borkh.) is a climacteric fruit cultivated in temperate regions of the world (Luby, 2003) with an annual production of 80.82 million tonnes from an area of 5.21 million hectares (FAO, 2013). Himachal Pradesh is also called as “Apple bowl of India” being an important apple producer state of the country with 0.105 million hectare under cultivation (Kuniyal and Hemlata, 2014). The residue left after extraction of juice from apple fruit is called apple pomace, which is an industrial waste and an environmental pollutant. Apple pomace is traditionally utilized as an animal feed ingredient, however, only a small fraction of apple pomace is used due to the rapid spoilage of the wet pomace. Apple pomace is highly succulent moist feed, providing a good source of digestible fibre that can be used as either a forage extender or concentrate feed. High moisture and fermentable sugar content of fresh apple pomace contributes to the rapid spoilage of the pomace and therefore requires either ensilage or dehydration of the pomace for longer preservation (Shalini et al., 2010; Crawshaw, 2004). Fresh apple pomace has an average of 4.5%CP content and it could be effectively used as an alternative animal feed resource. Mulberry foliage is characterized by high digestibility and excellent level of protein (20-24%), which makes it comparable to commercial concentrates for dairy cattle. Mulberry foliage can be ensiled satisfactorily without the need for additives such as molasses or rice bran (Ba et al., 2005).

Due to the acute scarcity of green fodder during winters and extreme summers in Himachal Pradesh, the conservation of fodder in the form of silage holds a great potential to meet the nutritional demands of the ever growing livestock population of the state. Silage is the product formed when grasses or other fodder crops with sufficient moisture and soluble carbohydrate content (e.g., sorghum and forage corn) liable to

spoilage by aerobic microorganisms is stored anaerobically. It is formed by the process referred to as ensilage which takes place in a vessel or structure called silo. Normally during ensilage, the fodder undergoes an acid fermentation in which bacteria produce lactic, acetic and butyric acids from sugars present in the raw material. The net result is a reduction in the pH which prevents the growth of spoilage microorganisms, the majority of which are intolerant to acidic conditions (Singh and Neelakantan, 2007). No study has been reported till date on utilization of apple pomace and mulberry leaves in the form of silage. Therefore, the study was undertaken to evaluate the nutritive value of mulberry leaves based apple pomace silage.

Methods and Study Site

The study was conducted at the dairy farm of Department of Silviculture and Agroforestry, Dr Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh during the years 2018 and 2019 with the objective to evaluate the nutritive value of apple pomace based silage and to evaluate the effect to feeding apple pomace silage on milk performance of dairy cows. In the first experiment fodder maize (Var. African tall) was harvested from the university field at milk stage. Fresh mulberry leaves were lopped from the agroforestry farm. Fresh apple pomace was procured from HPMC Parwanoo HP. Silage was prepared by chopping the maize and mulberry leaves in lengths of about 1-1.5 inches by a cutter. The ingredients were mixed in the different ratio with following treatment details i.e. Control (100% maize silage), T1 (80% maize + 10% apple pomace + 10% mulberry leaves), T2 (70% maize + 20% apple pomace + 10% mulberry leaves), T3 (60% maize + 30% apple pomace + 10% mulberry leaf) andT4 (85% apple pomace + 15% wheat straw). The experiment was conducted using randomized block design with four replications under each treatment. The silage bags were sealed in air tight conditions and it was made sure that no air is trapped inside the bags. The bags were covered, sealed and stored for a period of 60 days. Representative samples were collected from silage bags after 60 days storage and pH, dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF), neutral detergent fibre (NDF), acid detergent fibre (ADF), nitrogen free extract (NFE), total ash (TA) and acid insoluble ash (AIA) were determined according to the methods of Association of Official Analytical Chemists (AOAC 1990). The data recorded was analysed by using OPSTAT statistical software.

Results

The results on nutritive value of apple pomace based silage are presented in table 1. The inclusion of apple pomace increased silage CP in T1 (8.73), T2 (8.37) and T3 (8.83) compared to maize silage alone control (7.35). The inclusion of apple pomace reduced the CF and increased AIA of the silage suggesting that the silage was more digestible and high in minerals. Increasing apple pomace content in the silage at 10, 20 and 30 per cent resulted in the significant decrease in the pH, DM, CP, EE, CF, NDF, ADF, TA and AIA. However, the NFE content in the silage recorded an increasing trend with the same (table 1).

Inclusion of mulberry leaves in T1, T2 and T3 resulted in an increase in the CP content as compared to the control and T4. Although the CP contents decreased with increase in the apple pomace content, the content was higher than the control and T4, which can be credited to the inclusion of mulberry leaves as studies conducted by Shayo (1997), Ba et al. (2005), Alpizar et al. (2014) and Quadiri (2018) indicated that mulberry leaves have high CP (up to 22 %) content.

The study also revealed that inclusion of increasing contents of apple pomace in treatment T1, T2 and T3 resulted in decrease in CF, NDF and ADF contents. The CF, NDF and ADF contents were recorded highest in the silage which was made on addition of wheat straw and apple pomace. The ash and acid insoluble ash contents were also significantly influenced on addition of apple pomace and mulberry leaves in the silage. Highest ash and AIA content was observed in treatment T4 which subsequently declined on inclusion of apple pomace. The AIA content was recorded minimum in maize silage.

Discussion [Conclusions/Implications]

Pirmohammadi et al. (2006) reported that ensiled apple pomace contained pH of 3.4 and 7.2% CP. They also reported that the maize silage contained a pH of 4.6 and 26.0% ADF. In another study (Khan et al., 2014) also reported that normal maize silage had 3.48% EE and 21.3% ADF. Juracek et al. (2012) revealed that the maize silage contained 4.14, 7.65, 3.23, 18.27, 27.91 and 4.54 (% DM) pH, CP, EE, CF, ADF and ash content, respectively.

Kara et al. (2018) also reported that apple pomace silage contained 6.84 per cent crude protein and 3.66 per cent ash content. The crude protein content can be increased to 8.69 per cent on addition of 50 per

cent pomegranate pomace. They also reported that apple pomace had a mean value of 32.08 per cent CF and 30.34 per cent ADF.

Works on utilization of apple pomace as silage on inclusion of wheat straw has been conducted by Rodrigues et al. (2008) who reported that ensiling of apple pulp with different amounts of wheat straw resulted in pH value of 4.34 and 3.99 for inclusion of 70 and 85 per cent wheat straw respectively which were stored for a period of 60 days. Nazir (2017) also revealed in his study that ensiled apple pomace with wheat straw at 85 per cent resulted in pH value of 3.34 and that the pH increased with the decrease in concentration of apple pomace mixtures.

Table 1: The nutritive value of apple pomace based silage.

	pH	DM	CP	EE	CF	NDF	ADF	NFE	TA	AIA
Control (100% Maize Silage)	4.24^{a}	33.20^{b}	7.35^{d}	4.27^{a}	26.36^{b}	38.65^{d}	21.55^{e}	54.38^{e}	6.55^{b}	1.04^{e}
T1 (80% Maize + 10% AP + 10% mulberry leaf)	3.84^{c}	29.20^{c}	8.73^{a}	4.10^{b}	25.67^{c}	48.38^{b}	25.55^{b}	55.36^{d}	6.15^{c}	1.55^{b}
T2 (70% Maize + 20% AP + 10% mulberry leaf)	3.75^{d}	25.74^{d}	8.37^{b}	3.87^{c}	22.72^{d}	42.55^{c}	23.97^{c}	59.79^{b}	5.27^{d}	1.35^{c}
T3 (60% Maize + 30% AP + 10% mulberry leaf)	3.65^{e}	22.91^{e}	7.83^{c}	3.55^{d}	21.53^{e}	37.15^{e}	23.37^{d}	62.73^{a}	4.37^{e}	1.25^{d}
T4 (15% Wheat Straw + 85% Apple pomace)	4.05^{b}	39.11^{a}	6.52^{e}	3.29^{e}	27.46^{a}	50.59^{a}	27.27^{a}	56.18^{c}	7.65^{a}	2.15^{a}
Overall mean	**3.91**	**30.03**	**7.76**	**3.82**	**24.75**	**43.46**	**24.34**	**57.67**	**6.00**	**1.47**

*Means bearing different superscripts within a column are statistically different to each other

From the study it is evident that apple pomace along with mulberry leaves can be effectively included in maize based silage. On the basis of nutrient evaluation of apple pomace based silage treatment T1 (80% maize + 10 % apple pomace + 10% mulberry leaf) was found to be the best silage.Study concluded that the apple pomace, which is a potential environmental pollutant can be effectively incorporated in the silage and can be utilized for animal feeding.

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