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Determination of Feed and Silage Values of Some Vegetable Residues Left in the Field

Fatih ALAY[1*], Kadir İSPİRLİ[1], Ali Vaiz GARİPOĞLU[2], Ergin ÖZTÜRK[2], Necda ÇANKAYA[1]

[1]Black Sea Agricultural Research Institute, Samsun, Türkiye

[2]Department of Animal Science, Faculty of Agriculture, Ondokuz Mayıs University, Samsun, Türkiye

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A B S T R A C T

This study was conducted between 2013 and 2015 in the Çarşamba and Bafra districts of Samsun province to quantify the amount of post-harvest residues (kg da^{-1}), including stems, branches, leaves, and unmarketable fruits, most widely grown plants in the region and considered waste. Additionally, the quality and palatability of silages produced from these residues without additives were evaluated. In the study, tomatoes (T), fresh beans (FB), capia pepper (CP), pointed pepper (PP), white cabbage (WC), and red cabbage (RC) grown in 9 villages in Bafra district and 7 villages in Çarşamba district of Samsun were used. Maize (M) was used as a standard. The research was conducted to according randomized block design with 10 replications. The highest and lowest dry matter values in vegetable residues were obtained from T with 25.73% and WC with 14.68%, respectively. The highest and lowest amounts of residue taken from the unit area were obtained from WC with 2791.9 kg da^{-1} and FB with 988.6 kg da^{-1}, respectively. The highest and lowest values obtained from the silage analyses were as follows: pH (6.22 in T - 4.73 in WC), crude ash (38.95% in WC - 26.16% in FB), organic matter (73.87% in FB - 54.98% in WC), crude protein (15.86% in FB - 13.32% in FB), crude fat (3.17% in FB - 0.7% in CP), ADF (39.98% in PP - 16.96% in RC), and NDF (51.59% in T - 22.64% in RC), respectively. According to Flieg scores, it has been determined that CP is in the "good" quality class, FB, PP, WC, and RC are in the "moderate" value, and T is in the "low" quality class. According to the Relative Feed Values, it was determined that WC and RC were "highest", PP and FB were "very good", T and CP were "good" and all silages were consumed by animals in palatability tests. In the final scoring, the highest score after M was obtained from CP, followed by PP, FB, WC, RC, and the lowest score was obtained from T silage.

1. Introduction

Considering the bottlenecks in meat and milk production throughout our country, it is seen that the main issue is high production costs and the biggest cost factor is feed input. For this reason, it is widely accepted that an increase in competitiveness in domestic and foreign markets is possible by reducing feed costs. Calculations show that approximately 55 million tons of roughage is required annually based on dry matter in Türkiye. Our need for roughage, cannot be met with an average of 17-20 million tons of quality roughage obtained from the existing forage crops and

*Corresponding Author: fatih.alay@tarimorman.gov.tr

pastures (Çelik and Demirbağ, 2013; Özkan, 2020; Yavuz et al., 2020).

Roughage is defined as any material with a water content of more than 14% in its natural state or a crude cellulose content of more than 16% in dry matter and low in digestible organic substances and energy value (Akyıldız, 1983; Kılıç, 2000; Harmanşah, 2018; Oruç and Çolak, 2019).

In our country, apart from meadows, pasture and forage plants, which are among the sources of quality roughage production, there are other roughage sources with low forage value.The common basic characteristics of the roughage sources with low feed value are high crude fiber, lignin, and hemicellulose ratios, low energy content, crude protein, and digestible organic matter levels (Akyıldız, 1983; Jeroch et al., 1993; Gülsün and Miç, 2018; Harmanşah, 2018; Oruç and Çolak, 2019). However, these roughage sources are broken down into organic acids by cellulolytic bacteria living in the rumen of ruminant animals, and these acids are used in animal energy metabolism (Ensminger et al., 1990; Özel and Sarıçiçek, 2009; Tekce and Gül, 2014).

While studies on the improvement of pasture and forage crops continue in Samsun, which has been selected as the project area, it has been determined that abundant residues originating from vegetable agriculture, which constitutes a potential value for the region, have emerged. The residues in question have the potential to be used in silage production, which is a valuable feed source in ruminant (ruminant; cattle, sheep, goat, etc.) breeding.

It is known that there is a significant level of animal existence in Samsun. Although forage cultivation and production have increased 5-6 times in the last 10 years, when evaluated together with pastures, it is seen that roughage production is far from meeting the need.

In 2014, the roughage production of Samsun province, including silage, fodder crops, and pastures, was 350.9 tons on a dry matter basis (Anonymous, 2014). Considering the animal existence of Samsun province, the amount of roughage needed is 878.9 tons based on dry matter (Anonymous, 2014). These figures reveal that there is a high difference of 528.0 tons between production and need. It has been calculated that the residual mass that emerges after the production of only six species in vegetable agriculture in the region can be 456.6 tons and it is thought that some of the roughage needed can be met from here.

With this study, it is aimed to meet some of the insufficient roughage needs in livestock activities in Samsun by evaluating vegetable residues.

2. Material and Methods

The materials of this study were collected from farmer's land in 9 villages in Bafra district of Samsun and 7 villages in Çarşamba district between 2013-2015. The material was commercially produced Tomato (T) (Solanum lycopersicum), Fresh Bean (FB) (Phaseolus vulgaris), Capia Pepper (CP) (Capsicum annuum 6conoides), Pointed Pepper (PP) (Capsicum annuum var. longum), White Cabbage (WC) (Brassica oleracea var. capitata sub. var. alba), Red Cabbage (RC) (Brassica oleracea var. capitata sub. var. rubra) form the residual parts consisting of leaves, branches, stems and worthless fruits. As packaging material 5 kg yellow and 50 kg black plastic bags were used, and coarse table salt (3%) was used as an additive. The values for maize (Zea mays) silage were determined as the averages of the results of previous scientific studies (Also, maize silage was not used).

Residues of vegetable species were taken from parcels with an area of 3 da and above, which were determined to represent all production areas. The study was planned with 10 replications according to the randomized blocks experimental design and the results were analyzed with the Jump statistical program and the obtained data were compared with the LSD multiple comparison test. In the selected districts in Samsun province, 10 fields were determined each representing the province from T, FB, CP, PP, WC, and RC vegetable types. Residues were collected from three distinct sites to accurately represent each parcel, and care was taken to ensure that the parcels chosen as application subjects were at least 3 da. For each replication, in order to represent the selected field homogeneously, three samples were taken from the harvested areas for each species, and then weighed and mixed. To determine the dry matter ratios of the raw materials, 500 g of green parts were taken to represent the mixture. The DM ratios were determined by drying it in an oven at 60 C0 for 72 hours. Yields per unit area were found by dividing the total weight of the harvested material and the harvested area per unit area (da). The material to be silaged was kept for one day after harvest, then cut into 2-5 cm pieces, filled into 5 and 50 kg plastic bags by adding 3% salt, and sealed by vacuuming. For physical and chemical analyses 5 kg bags, and for palatability tests, 50 kg bags were used. Silages were opened after their fermentation was completed in 60 days. For the analysis, the silage samples of 500 g each were dried in a drying oven at 60 °C for 72 hours, and the dry matter ratios were determined. Silages obtained from plant residue materials were used to determine the dry matter (DM), crude protein (CP), crude oil (CO), crude fiber (CF), and crude ash (CA) and the analyses were made according to AOAC (1990). The analyses of acid detergent fiber (ADF) and neutral detergent fiber (NDF) were performed according to Van Soest et al. (1991). The analysis were conducted using the Ankom fiber detector. For the volatile fatty acids (VFA; acetic acid, butyric acid, and lactic acid) determination, the Lepper method was used. Sensory and physical analyses and pH measurements were conducted as reported by Karabulut and Canbolat (2005). The residual material was harvested in 10 fields (parcels) of T, FB, CP, PP, and WC types and 8 fields of RC type. Due to soil cultivation being done without waiting after harvest, RC type material could not be obtained in two plots. In the selection of the plots, the distribution of the species in question throughout the province was taken into account. The waste collection process of the applications was carried out after the commercial harvest of the vegetables. The places where vegetable residues were collected and the number of areas are given in Table 1.

Table 1. Districts and villages where the study was conducted according to the application subjects.

Species	Location	Villages
T	Bafra	Karpuzlu (2), Doğanca (5), Koşu (2), Agıllar (1)
FB	Çarşamba	Ahubaba (1), Durakbaşı (2), Karamustafalı (3), Ovacık (2)
CP	Bafra	Karıncak (2), Türbe (2), Koşu (3), Doğanca (2), Yeşilyazı (1)
PP	Bafra	Karpuzlu (1), Koşu (2), Türbe(2)
	Çarşamba	Karamustafalı (1), Kumtepe (2), Kurugöl (1), Bölmeçayır(1)
WC	Bafra	Türbe (2), Karıncak (5), Karpuzlu (1), Sarıköy (2)
RC	Bafra	Karıncak (3), Koşu (1), Türbe (2), Sarıköy (1), Doğanca (2), Altunova (1)

Waste collection work was carried out in 15 different parcels in 7 villages in Çarşamba district and 45 different parcels in 9 villages in Bafra district. For T, CB, WC, and RC residual collection was carried out only in Bafra district. FB was only collected from Çarşamba district, whereas PP was collected from both Bafra and Çarşamba districts. An average of 6 calico cows of OMU Faculty of Agriculture in the 3rd and 4th lactations were used for the palatability tests. First of all, an exercise period was applied to the animals to prevent diarrhea. Each silage was fed to 2 animals. In the experiment, 1, 2, 4, 6, 8, 10, and 12 kg of silage were used and a total of 258 kg of residual silage of each species was used. The animals were fed with silage after morning and evening milking. In addition, the animal's feed consumption was observed every two hours. Rejection threshold, low difference threshold, high difference threshold, and preference threshold which are considered preference index values were defined as 20%, 40%, 60%, and 80% (consumption rates of dry matter given at the start), respectively. The green yield of the maize plant and the chemical and technological values of the silage feed was taken as the average of the values obtained from the previous studies carried out in our country (İptaş, 1993; Alçiçek et al., 1999; Filya, 2004; Çiğdem and Uzun, 2006; Karayiğit, 2005; Özdüven et al., 2009; Erdal et al., 2009; Özata et al., 2012; Çakmak et al., 2013; Konca et al., 2005; Kavut and Geren, 2015; Kaplan et al., 2017; Kökten et al., 2017; Kokten, 2020). Comparison data of corn silage is given in Table 2.

Table 2. Basic comparison data of maize silage.

Silage Material	% DM	pH	CP	CA	RFV	Yield (kg da^{-1})	Palatability Score	Sensory test Score	OA Score
Maize	28.38	4.06	7.16	7.28	150<	6139.50	100.00	19	63

The "weighed grading method" was used to score the wet residue yield of the residual materials of the maize plant as the comparison material and the pH, sensory tests, DM, CP, CA, RFV, OA (organic acid), and palatability tests of the silages by putting them into a single table (Serdar, 1994; Demirsoy, 1999; Çelikel, 2005). Scoring was determined separately for each data out of 10 points. Accordingly, the Könisberg method was used in scoring pH and sensory tests. In the scoring of pH assessments scoring was made between 0-4. The obtained scores were processed according to the "score*10/4" formula. In the evaluation of color, smell, taste, and structure of sensory tests, the best and worst values (0-4 / 0-7 / 0-4) were scored. The total score obtained was in the range of 0-20, so it was used in the "10 / 20 * score" formula. processed accordingly. Green residual values were processed according to the formula "yield*10/ highest yield". DM values were evaluated between 0-35%, 2 points between 0-15%, and 2 points were added for each 5% increase. CP values were scored as 0-15% and 16=<, 1 point between 0-8, and then the scoring was increased by 1 in every 1-unit interval and 16+ was accepted as 10 points. CA values were evaluated between 0-40%, 0-10% was accepted as 10 points, and every 5% increase was reduced by 1 point. RFV values were scored as 0-9 points in the range of 40-150 and above 150 as 10 points. OA values were scored between 1-10 points, with a 1-point increase for every 10-point increase in the score range of 0-100. The score for the palatability test values was created according to the "preference index values", and every 10% value between 10-100% was evaluated as a point and scored between 1-10.

3. Results

3.1. Dry Matter Ratio and Wet Residual Yield

Table 3. DM ratios and wet residue yield of the residues that are the subject of the application.

Species	DM (%)	Fresh residual yield (kg da^{-1})
T(Tomatoes**)**	25.72 A	1.083 C
FB(Fresh Beans)	18.84 C	988.6 C
CP(Capia Pepper)	21.94 BC	1.867 B
PP(Pointed Pepper)	23.52 AB	2.515 A
WC(White Cabbage)	14.82 D	2.662 A
RC(Red Cabbage)	20.12 C	2.188 AB
Average	**20.82**	**1.884**
CV (%)	16.50	33.06
Level of Importance	**	**
LSD (0.05)	3.09	5.61

When Table 3 is examined, the highest DM ratio was determined in T residue, followed by PP, CP, and RC, and the highest residual yield was determined from WC, PP, and RC.

Table 4. Green part residue production in the species studied in Samsun in 2014

Working Area	Species	Year	Cultivation Area (da)	Residue Yield (Ton/da)	Total Fresh Residue Production (Ton)
Samsun	**T**	2014	51.034	1.082	55.218
	FB	2014	82.093	0.988	81.107
	CP	2014	27.480	1.867	51.305

	PP	2014	55.344	2.514	139.134
	WC	2014	28.936	2.791	80.760
	RC	2014	22.440	2.188	49.098
Total			**267.327**		**456.622**

When Table 4 is examined, it is seen that the highest residue production in Samsun is obtained from the PP type with 139.1 tons. The least amount of residue is obtained from the RC type with 49.1 tons. A total of 456.6 tons of waste material was produced from six vegetable types (Anonymous, 2014).

3.2. Analysis and Findings Conducted in Silo Feed

3.2.1. pH and Sensory Tests

Table 5. pH, sensory tests, and the Flieg score values in silage of vegetable residues

Species	**pH**	**Flieg Point**	**Score**	**Sensory Test**	**Score**
T (Tomatoes)	6.22	22.0	**Low** (21-40)	13.0	**Moderate** (10-13)
FB(Fresh Beans)	4.93	59.0	**Moderate** (41-60)	13.0	**Moderate** (10-13)
CP(Capia Pepper)	4.88	61.0	**Good** (61-80)	13.5	**Moderate** (10-13)
PP(Pointed Pepper)	5.47	47.0	**Moderate** (41-60)	10.5	**Moderate** (10-13)
WC(White Cabbage)	4.73	52.43	**Moderate** (41-60)	15.84	**Good** (14-17)
RC(Red Cabbage)	5.19	49.75	**Moderate** (41-60)	14.73	**Good** (14-17)

Standard pH ranges are 3.5-5 (Kutlu, 2011). In silage samples, the highest pH value was determined at T and the lowest at WC. The pH values of PP, T, and RC species were above the limit values specified in the literature. In terms of sensory tests, it was determined that WC and RC have "good" values, while T, FB, CP, and PP resulted in "moderate" values. According to the Flieg scores, it was determined that CP was in the "good" quality class, FB, PP, WC, and RC were in the "moderate", and T was in the "low" quality class (Table 5).

3.2.2. Nutrient analysis

Table 6. CP, CA, OM, CO, ADF, and NDF analysis results in silage of vegetable residues

Species	**DM (%)**	**CA (%)**	**OM (%)**	**CP (%)**	**CO (%)**	**ADF (%)**	**NDF (%)**
T	29.34 A	31.40 B	68.59 B	15.03 AB	2.64 AB	38.48 AB	51.58 A
FB	25.70 B	26.15 C	73.87 A	15.85 A	3.16 A	34.60 B	46.48 A
CP	25.68 B	27.91BC	72.08AB	14.51 ABC	0.76 E	38.70 AB	48.29 A
PP	28.01 A	27.03 C	72.96 A	14.05 BC	1.72 CD	39.97 A	49.64 A

WC	18.31 D	35.95 A	57.68 C	13.32 C	2.15 BC	18.12 C	24.17 B
RC	20.63 C	38.49 A	54.97 C	13.34 C	1.38 DE	16.95 C	22.63 B
Average	**24.61**	**31.15**	**66.69**	**14.3**	**2.21**	**31.142**	**40.47**
CV (%)	10.17	13.29	5.8	**13.02**	36,9	15.6	14.05
Level of Importance	**	**	**	*	**	**	**
LSD (0.05)	2.24	3.73	3.53	1.68	0.65	4.39	5.12

In DM, CA, CO, OM, ADF and NDF analyzes, the difference between species was found to be statistically very significant, in CP analyzes the difference between species was statistically significant. DM contents in silages T and PP are in the same group in residual silages. The lowest DM rates were obtained from WC and RC. When the CA assets were examined, it was determined that WC and RC had the highest CA presence and were in the same group. T and RC were in the second group, and the lowest CA presence was in FB and PP. When OM values are examined in terms of their direction, the highest to lowest OM values were found in FB, PP, CP, T, WC, and RC, respectively. When the CP ratios are examined, the highest value was obtained from FB, followed by T, and PP, while the lowest was found in silages obtained from WC, and RC. As for their CO yields, the highest CO value was obtained from FB, followed by T, WC, PP, RC and CP, respectively. In terms of ADF ratios, the highest ADF ratio was determined in PP, CP and T, followed by FB. The lowest ADF was determined in WC and RC. While the highest NDF ratio was T, FB, CP, PP, the lowest NDF value was determined in RC and WC (Table 6). RFV values in silage of vegetable residues are given in Table 7.

Table 7. Relative feed values in silages of vegetable residues subject to application

Species	RFV	Score
T(Tomatoes**)**	116.74	Good (124-103)
FB(Fresh Beans)	134.55	Very good (151-125)
CP(Capia Pepper)	122.82	Good (124-103)
PP(Pointed Pepper)	125.98	Very good (151-125)
WC(White Cabbage)	291.38	Very good (>150)
RC(Red Cabbage)	317.26	Very good (>150)

Relative Feed Value was found to be "good" and "very good" in all vegetable species subject to the application. Relative feed values were very high in WC and RC species.

3.2.3. Organic Acid analyzes

Table 8. AA, BA, and LA values in the silage of the vegetable residues that are the subject of the application

Species	% LA*	% AA*	% BA*	Fleig Points	Score
T	0.96	2.24	-0.78	50.5	III = Satisfactory
FB	1.47	2.12	-0.28	39.7	IV = Moderate
CP	0.65	0.43	-0.04	65.8	II = Good
PP	1.00	0.68	-0.08	68.6	II = Good
WC	1.67	4.10	-2.61	55.5	III= Satisfactory
RC	1.45	0.35	-0.02	88.2	I = Very good

*LA (Lactic acid), AA (Acetic acid), BA (Butyric acid)

The most ideal limit values for LA are ≥ 2%, AA < 0.8%, BA = 0 (Kılıç, 2006; Kılıç, 1986; Alçiçek and Özkan 1996). While RC was "very good", CP and PP were "good", T and WC were "satisfactory", FB was "moderate" in the vegetable species subject to the application (Table 8).

3.2.4. Palatability Tests

Table 9. The results of palatability tests in silage of vegetable residues

Species	**Consumption (%)**	**Feed amount (kg day)**						
		1	**2**	**4**	**6**	**8**	**10**	**12**
T	Consumed	80	80	100	100	100	100	100
	Remaining	20	20	x	x	x	x	x
FB	Consumed	100	100	100	100	100	100	100
	Remaining	x	x	x	x	x	x	x
CP	Consumed	100	100	100	100	100	100	100
	Remaining	x	x	x	x	x	x	x
PP	Consumed	100	100	100	100	100	100	100
	Remaining	x	x	x	x	x	x	x
WC	Consumed	100	100	100	100	100	100	100
	Remaining	x	x	x	x	x	x	x
RC	Consumed	100	100	100	100	100	100	100
	Remaining	x	x	x	x	x	x	x

Initially, some reluctance was observed in the consumption of T silage at 1 and 2 kg day applications. In all other applications, all the silages given were consumed by the animals (Table 9).

Table 10. Combined final scoring table of some physical and chemical properties of the silages of the studied species and the comparative material

Species	**Residual yield (0-10)**	**pH (0-10)**	**Sensory Test (0-10)**	**DM (0-10)**	**CP(0-10)**	**CA (0-10)**	**RFV (0-10)**	**OA (0-10)**	**Palatability test (0-10)**	**Total (points)**
T	1.51	0	6.5	8	9	5	7	6	9	**52.01**
FB	1.38	2.5	6.5	8	9	6	8	4	10	**55.38**
CP	2.6	2.5	6.75	8	8	6	7	8	10	**58.85**
PP	3.5	0	5.25	8	8	6	8	8	10	**56.75**
WC	3.9	2.5	7.92	4	7	4	10	6	10	**55.32**
RC	3.05	0	7.36	6	7	4	10	9	10	**53.36**
M	10	7.5	9.5	8	1	10	9	9	10	**74**

When the values of residual silages from all evaluation criteria are scored in a single table, the comparison material maize (M) has the highest value with 74 points, followed by CP, PP, FB, RC, and WC, respectively. Type T had the lowest value with 52.01 points (Table 10).

4. Discussion

The DM ratios of the residues of the studied species ranged from 18.68% (WC) to 25.73% (T). Considering that the DM ratio of the maize plant is 34.75%. The DM rates of the species in the study were lower when compared to maize. The DM ratio required to make silage feed in water-rich materials should be between 25-35% (Kutlu, 2011 For the vegetable species that are the subject of the application in the study, only residue obtained from T falls within this range. In a study conducted by Ozkul et al. (2011), where some values of different vegetable residue mixtures, wheat straw and wheat bran were evaluated, the DM contents of vegetable mixtures were found to be 12.16%. DM content of silage prepared from Chinese cabbage residues was reported as 13.5% in a research by Kafle et al. (2014). In silage studies to be carried out with the materials under study, to increase the DM ratio of the materials, it can be considered that withering, mixing with other materials with high DM ratio at certain rates, or making silages after removing the high percentage of water in their structure by mechanical methods.

In terms of yield per unit area, there is a high difference between the comparison material M plant and materials used in this study. The closest yield value to M (6139 kg da^{-1}) was obtained from PP, RC, and WC species. In the previous literature, there are very few studies on the determination of yield values per unit area in the species that are the subject of the application. In the study, the residues left over from tomato cultivation in open areas were found to be 1082 tons da^{-1}. Di Blasi et al. (1997), "The yield per unit area of tomato residues in greenhouses is 1.3 tons da^{-1}", Kürklü et al. (2004) reported that only 111.481 tons of dry matter from tomato greenhouses and 15.8 tons from eggplant greenhouses are produced in the Antalya region, where intensive greenhouse cultivation is carried out. The reasons for the difference may be due to regional, aquaculture, species, decare, and total yield differences.

Acceptable pH values in silo materials vary between 3.5-4.9 (Kutlu, 2010). The average pH value of M silages was found to be 4.06. As for the materials used in this study, it was determined that WC, CP, and FB, have pH values within the acceptable range together with M. Whereas T, PP, and RC have pH values above the acceptable range values.

Ozkul et al. (2011) found that pH values in 7 different silages made from vegetable residues were between 4.09 and 4.20. In a study conducted by İptaş (1993), pH values were found to be between 4.25-4.6 in 3 different corn varieties, 6.15 in bean residue and 5.3 in cowpea. Kafle et al. (2014) reported a pH value of 5.8 in silage prepared from Chinese cabbage residues. When the pH values in all three literatures above are examined, it can be seen that the pH data obtained from subjects other than M are in parallel with the data from our study.

In the study, the CP value was determined to be between 13.32-15.86%. Whereas the CP value in the comparison material M is 7.16%. In roughage, CP is a very important criterion. All of the materials used in this study nearly have a CP ratio of 2 times more than the benchmark material. It is thought that the reason for the high pH value of the silages obtained from the examined species is due to their high CP content and low water-soluble carbohydrate content. Ishida et al. (2000) reported that easily soluble carbohydrates should be added for better fermentation and silage quality due to the high protein content in silages made with sweet potato leaves.

Color, odor, and structure were examined in the evaluation made in terms of physical properties, and it was seen that WC and RC were "good" and other applications were "moderate". Although there are acceptable data, it is thought that this result may be due to the low DM content of the residues collected from the field, especially the worthless fruits, and possible decay.

While the DM ratios of T and PP species in silages of vegetable species were statistically in the same group, FB and CP were in a subgroup. The lowest DM rate was determined in WC and RC species. The DM ratio obtained from silages obtained from maize plant is 28.38% and the ratio is the same as T. While the DM rate of M silage is expected to be higher, it is thought that it is due to silage being made earlier than necessary uncontrolled farmer conditions. It is thought that the main reason for the low DM rate of the residues in the study is due to the high water content during harvest. Vilela de Rezende et al. (2015) found DM between 20-25% in their study investigating the silage possibilities of milled maize added cabbage residues. No DM value can be compared with the DM value obtained in our study since cabbage residues were not siled up alone in the study in question. However, the fact that the DM content is so low even in the ground maize added silage reveals that the DM values determined for WC and RC in the current study (18.31% and 20.63%, respectively) are at an acceptable level. It is thought that increasing the DM ratio of silage materials will make the study more successful. Increasing the DM ratio of silage materials will make the study more successful. Obtaining a high DM ratio can be achieved by withering, mixing with materials with high DM ratios, making silage, or processing the high water content in the materials by crushing or squeezing. However, considering that the harvest dates of these materials are between September and February, and considering the abundance of autumn rains in the region, there may be limitations in withering. Opportunities to make silage by mixing with materials with high DM content or by breaking them in one go by methods that can be developed during harvesting from the field, and then by squeezing or centrifugal effect. It is thought that the possibility of increasing the DM ratio by removing the water should be investigated.

In the evaluation of CA rates, it can be seen that the CA value varies between 26-38% in all application subjects. Considering that the CA value of M is 7.28%, the CA values of the application materials are very high. Ozturk et al. (1998) investigated the possibilities of using amaranth (Amarantus cruentus) as silage feed and determined the CA ratio in silages of amaranth plants grown at 5 different nitrogen doses between 16.7-18.9%. It is thought that the main reason for the high CA ratio in our study may be due to the 3% salt added over the weight of the residues during silage production and the soil material with a high probability of contaminating the residual materials, especially for T, WC, and RC types.

When ADF and NDF values were examined, it was determined that ADF was between 34.61-39.98% and NDF was between 46.48% and 51.59% in T, FB, CP, and PP. In RC and WC, it is seen that ADF values are very low, between 16.96-18.13%, and NDF between 22.64-24.17%. In their study, Özkul et al. (2011) determined that OM 82.72%, CP 22.59%, ADF 26.49%, and NDF 28.69% in silages obtained from 100% vegetable mixture residues. Binversie and Miller. (2013), in the study evaluated comparatively the nutritional contents of maize silage and cabbage silage, where they determined that DM in cabbage was 7%, CP 16.6%, ADF 15.8%, NDF 29%, DM 35%, CP 8.5%, ADF 24%, NDF 43%. Agneessens et al. (2014), in their study, determined the quality values of vegetable and orchard residues compost and silage, vegetable residues silage, and fresh vegetable residues, they found DM of the silage obtained in the section related to vegetable residues to be between 16.1-19.2%. When the data in these studies are compared with the data obtained from our study, the ADF and NDF values of the materials with low DM ratio decreased accordingly, and therefore the low ADF and NDF values of WC and RC can be explained in this way.

ADF and NDF values were also determined as low due to the medium and low DM % ratios in silo feeds. As a result, RFV was found to be good and very good in all application subjects. ADF and NDF values, which are very low, especially in cabbage species, have maximized the RFV value of these materials.

The LA values in the residual silages of the species are low when compared with the literature data. Accordingly, the amounts of AA and BA increased. As a result of scoring the current findings, fleig scores in all species revealed values between moderate and good. If the cabbage residues are ensiled without additives, the lactic acid level decreases and it is not possible to obtain quality silage (Cao et al., 2011).

Compared to other bacteria, lactic acid bacteria can develop best in an oxygen-free environment (15-25 C°), at a pH of 4-5, in 35-40% dry matter, and if the silo feed contains 2-3% sugar (Alçiçek et al.1999. The required LA level in silage feeds is 2% (Kılıç, 2006). The low LA values can be explained by the high CP values of the species and the low carbohydrate content.

5. Conclusion

When the time of consuming the silage of the animals was followed, it was observed that they consumed the CP and PP silages more eagerly. Between April 1st and October 1st, when green fodder is abundant in nature, the roughage needs of animals are provided by nature or from the roughage stock of the enterprise. Grain silages and maize silages, which are more preferred by animals, are mostly consumed in the early winter and early spring periods. Considering the daily caloric needs of the animals, it is thought that it would be more appropriate to feed the silages that are the subject of the study in the winter period and can be consumed more lovingly in this period. As a result of the evaluation of the study materials as silage in Samsun, it is thought that a significant part of the roughage that the province will need can be obtained from here. There has been no problem in the consumption of silo feeds obtained from waste materials by animals. Although there is little reluctance in T type silages, it has been observed that they consume all other types with pleasure. It has been determined that the best quality and preferable silage feed is KB when compared to the M material in terms of silo feed quality, and then PP, FB, WC, RC, and T can be preferred, respectively. Mechanization practices that will ensure the removal of high water content by crushing and squeezing the waste materials during harvest and centrifugal effect when necessary. It is thought that it may be appropriate to mix the vegetable species under study with different silage materials which are rich in carbohydrates. This will increase the DM ratio, in certain proportions. For these materials, which have production potential and substantial feed values, to be used as silage feed, it is beneficial to improve their quality values and to develop mechanization methods and practices that will facilitate harvesting and silage production.

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