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DIFFERENT VEGETATION PERIODS HARVESTED SAINFOIN NUTRIENT INGREDIENT AND CONDENSED TANNIN CONTENTS

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Abstract

This study was carried out to determine green, dry herbage yields and most suitable harvest period of sainfoin. Also, it was made in order to determine amount of nutrient matter and condensed tannin. Samples were collected from seven different trial fields in four different harvest periods (beginning of budding, 10% flowering, 50% flowering and seedpod) and four replications. There was no statistically significant difference between the average of the field at each harvest period (p=0.80). In terms of dry matter ratio, there was a statistically significant difference between harvesting periods from budding to seedpod period (p=0.001). There was a statistically significant difference in crude protein, NDF and ADF parameters depending on the progress of harvest period (p=0.001). There was a statistically significant difference in terms of metabolic energy (ME-3X) parameter depending on the progress of harvest period (p=0.001). At harvest periods, there was respectively 4.42%, 4.92%, 5.93%, 7.59% extractable condensed tannin values. There was a statistically significant difference between harvesting periods in terms of condensed tannin parameter (p=0.001).

Key words*: harvest, hay, herbage, nutrient, sainfoin.*

INTRODUCTION

Alfalfa, sainfoin, vetch such as many traditional forage crops are cultivated. Turkey Statistical Institute (TÜİK), according to 2017 data, our country has approximately 14.6 million hectares of meadows and pastures. In addition, forage plant sowing area sainfoin; alfalfa, corn silage, common vetch is the 4th and approximately 1.9 million decares of land is cultivated and approximately 1.650.000 tons of sainfoin green herbage is obtained. In terms of forage production data, sainfoin, alfalfa and vetch are important. Between 2007-2017 years, there is a regular increase in sainfoin cultivation areas (Anonim, 2017). On the other hand, green herbage yield fluctuates due to various reasons, mostly due to precipitation regime. Sainfoin is defined by the words "Sain" and "Foin", "Sain" healthy and "Foin" grass means. So, the name of the sainfoin is "healthy herbage". This name has changed to English as well. A project supported by the European Union and focused on sainfoin was named "Healthy hay" as the project title. In some sources, it is also called "holy hay". In Greek, sainfoin is expressed by ónos (ὄνος, donkey), which means donkey's favorite fodder (Ruprecht, 2005; Smith, 2011; Carbonero, 2011; Carbonero et al., 2012). Sainfoin plant according to the harvest, of the beginning of flowering, 10% flowering, 50% flowering and seedpod is classified into four periods. It is possible to grow in an area with an altitude of 100-2500 m (García Salmerón et al., 1966; Demdoum, 2012). Sainfoin has attracted intense interest in animal husbandry due to its pasture potential. Although alfalfa (*Medicago sativa*) is a quality forage plant in terms of nutritional values, it is more suitable for irrigated agriculture. Sainfoin (*Onobrychis sativa* Scop.) is more resistant to cold and more suitable for growing in dry areas than clover. Sainfoin is equivalent to alfalfa in terms of nutrient content (Temel, 2010). Sainfoin cultivation can be expanded to reduce feed costs and organic livestock. Forage-derived organic livestock can be used with less concentrated feed and more sainfoin (Ecocrop, 2009). Sainfoin has a cell wall structure similar to alfalfa and has a better water soluble carbohydrate and energy/nitrogen concentration. Nitrogen in sainfoin is better evaluated by ruminants, although it has a lower protein content than alfalfa. The tannins in the plant bind proteins and protect them from

microbial degradation in the rumen. Most of the condensed tannin concentration is in the leaves. In general, the amount of condensed tannin in the sainfoin decreases as the plant matures. This decrease is related to the decrease in tannin content in the leaves (Li et al., 2013). It has been reported that tannin concentration of 4% to 10% of sainfoin has beneficial effects for ruminants (Min et al., 2003). The proteins in legume feeds cannot be used sufficiently by ruminants due to their rapid destruction in the rumen (Broderick, 1995; Gebrehiwot, 2002; Min et al., 2003). When plants containing tannins are consumed, degradation of proteins in the rumen to ammonia occurs at a low rate. Tannins reduce the degradation of plant proteins and thus allow the formation of by-pass proteins (Aerts et al., 1999; McMahon et al., 2000; Waghorn et al., 2008). The nutritional value of sainfoin is lower than alfalfa. This decrease can occur due to loss of leaves during hay production and can be consumed as fresh feed to prevent. However, since the condensed tannins protect the protein, the proteins in the sainfoin silage are better protected than proteolysis. In silage production Sainfoin's high carbohydrate concentration helps to make the silo faster. Açıkgöz (2001), when the nutrient content of the preservative according to the harvest period; 21.20% crude protein, before flowering 2.10% crude oil, 22.30% crude cellulose, 44.70% non-nitrogenous substance; 18.90% crude protein at the beginning of flowering 3.20% crude oil, 29.80% crude cellulose, 42.60% non-nitrogenous substance, 17.30% crude protein; in 100% flowering period 3.0% crude oil, 33.70% crude cellulose. It has been reported that 41.00% contains nitrogen-free substance. In a research, chemical analysis on sainfoin hay was performed in different vegetation periods. Analyses were made at the beginning of flowering, flowering and seedpod periods. In this study, NDF contents respectively were 46.14%, 49.27% and 55.71%; ADF contents 33.40%, 37.21% and 40.15%; ADL contents were 7.10%, 8.20% and 11.10%; crude protein contents 19.5%, 14.5% and 13.05%; crude ash contents were 8.31%, 6.88% and 7.18%. In addition, condensed tannins were reported as 10.51%, 6.96% and 4.26% (Bal et al., 2006). According to the harvest period green herbage yield is between 700-1500 kg/de and is less than alfalfa. In the experiments conducted in Şavşat region in Turkey, yields of green herbage were determined between 1566 kg and 1734 kg at an altitude of 850-1010 m. It has been reported that green herbage and hay yields of sainfoin plant vary depending on soil structure and elevation of cultivated area and there is a significant decrease in yield at 1475 m altitude. In a study reported that the yield of dry herbage of the sainfoin is between 300-700 kg/de (Koivisto and Lane, 2001; Temel, 2010). 831 kg/de in dry conditions and 645 kg/de in dry conditions were obtained (Erkovan and Tan, 2009). Green herbage yields of sainfoin varieties (Koç 1461, Emre, Yunus, Fatih, Mehmet alibey and Hilal) cultivated in Altınova and Gözlü farm belonging to the General Directorate of Agricultural Enterprises (TİGEM) were 2077-2674 kg/de; hay yields were reported to be 456-575 kg/de (Koç and Akdeniz, 2017). In a study investigating the effects of different nitrogen ratios on growth and development; Green herbage yield of Siberian sainfoin 167-201 kg/de; hay yield was found to be 59.50-79.05 kg/de (Kılıç, 1991). This study was made order to determine the most suitable harvest period, green and dry herbage yields, also nutrient components and amount of condensed tannins in sainfoin.

Table 1. Altitude and coordinates of sainfoin samples

Village	District	Altitude	Coordinate
Boğazdere	Ulaş	1566	39°22'37.1"N-36°55'14.8"E
Çevirme	Ulaş	1685	39°16'06.8"N-36°56'16.2"E
Center	Altınyayla	1537	39°16'27.7"N-36°45'54.8"E
Kocakurt	Kangal	1493	39°10'09.3"N-37°14'55.6"E
Kuşkayası	Kangal	1509	39°10'18.2"N-37°14'59.0"E
Kızılören	Gürün	1677	38°47'11.0"N-37°12'23.0"E
Böğrüdelik	Gürün	1788	38°57'38.4"N-37°17'10.0"E

MATERIALS AND METHODS

Ulas, Altınyayla, Kangal and Gürün districts from province of Sivas in Turkey, seven different trial fields in four different periods (budding, 10% flowering, 50% flowering and seedpod) and four replications of were taken samples of sainfoin fields (Table 1). Samples were taken from random areas by drawing zigzags in the field with quadrate of 50 x 50 cm dimensions from each repetition. After the samples were dried after weighting, for chemical analyses were carried out in Selcuk University Faculty of Veterinary Medicine Animal Nutrition and Nutritional Diseases Department Feed Analysis Laboratory. AOAC (1999), conducted dry matter, crude protein, crude oil and crude ash analysis in accordance with the reported methods. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) levels were determined in Ankom 200 Fiber Analyzer according to the method reported by Van Soest et al. (1991). Protein fractions analysis was performed according to the method reported by Krishnamoorthy et al. (1982); condensed tannin analysis was carried out according to the acid-butanol method (Bate-Smith, 1975). SPPS 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0, Armonk, NY: IBM Corp.) statistical package program was used for the evaluation of the data.

Table 2. Data of 1930-2018 years and 2016-2017 years temperature (℃) and precipitation (mm) in Ulas, Altinyayla, Gürün and Kangal districts of Sivas (Mevbis, 2018; MGM 2019)

Temperature (℃)										
	2016				**2017**					
	Month				**Month**					
	9	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**
Ulaş	14.20	10.71	3.80	-4.90	-5.14	-3.40	4.22	8.11	12.13	16.57
Altınyayla	12.90	9.05	2.28	-4.51	-5.58	-3.97	3.52	7.80	11.65	15.89
Kangal	13.00	8.84	1.64	-6.84	-8.41	-6.29	2.79	7.04	11.34	16.17
Gürün	17.28	12.91	4.16	-2.58	-5.57	-3.08	4.25	9.88	14.60	21.23
Average temperature in Sivas (1930-2018)	16.1	10.8	4.7	-0.7	-3.5	-2.1	2.7	8.9	13.5	16

Precipitation (mm)											
	2016				**2017**						
	Month				**Month**						
	9	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**mean**
Ulaş	17.4	4.0	7.7	36.3	29.6	1.9	34.8	55.8	66.7	27.5	281.7
Altınyayla	14.0	2.8	8.7	34.6	33.3	9.5	25.4	36	62.2	41.1	267.6
Kangal	6.0	2.4	3.0	21.6	18.2	1.4	27.8	47.8	59.2	6.8	194.2
Gürün	19.0	4.2	3.1	42.6	16.9	0.9	26.7	55	43.8	3.4	215.6
Average rainfall in Sivas (1930-2018)	17.3	33.4	40.5	44.8	43	39.2	45.1	57.1	61.6	33.8	415.8

RESULTS AND DISCUSSIONS

Mean yields of green herbage of seven different trial fields for the budding, 10% flowering, 50% flowering and seedpod periods were respectively found 1869 kg, 1644 kg, 1800 kg, 1704 kg (Table 3). In terms of average hay yields of the trial fields, the average yield for the budding, 10% flowering, 50% flowering and seedpod periods,

respectively was obtained 436.28 kg, 423.16 kg, 485.52 kg, 482.83 kg. In a study conducted on Siberian sainfoin, green herbage yield was 167.78-201.90 kg/de and dry herbage yield was lower than 59.50-79.05 kg/de (Kılıç, 1991). Büyükburç (1991), 250-350 kg/de dry herbage yield with less than the current study; In a study conducted in İzmir, green herbage yield of 1890 kg/de and 350 kg/de of dry herbage were obtained from sainfoin in the same year. Also; sainfoin has 481.20 kg/de yield of dry herbage (Sea et al., 2005).

Deniz et al. (2005), by budding, 25%, 50%, 100% flowering and seedpod period respectively have been reported 2861 kg, 3603.30 kg, 3473.30 kg, 3840 kg, 3330 kg. Green herbage yield is higher than the current working average. But, Deniz et al. (2005) has similarities with the yield amount determined by the budding and 10% flowering periods in Kuşkayası village of Kangal district. But; Deniz et al (2005) obtained better results than the present study in terms of average yields.

Table 3. Green and dry herbage in the experimental field crude protein, ME (metabolic energy) yield (kg/decare)

Green herbage yield					
	Budding	**10% flowering**	**50% flowering**	**Seedpod**	
	$\bar{x}\pm S_{\bar{x}}$	**$\bar{x}\pm S_{\bar{x}}$**	**$\bar{x}\pm S_{\bar{x}}$**	**$\bar{x}\pm S_{\bar{x}}$**	**p**
Boğazdere	2593±251.56	1720±98.02	1754±131.04	2028±129.14	0.25
Çevirme	1904a±211.27	1545ab±109.69	1177b±179.27	1282b±157.49	**0.01**
Altınyayla	1635±258.85	1500±251.36	1443±206.78	1546±146.24	0.89
Kocakurt	2407a±892.21	1820b±215.34	2993a±195.56	2099b±239.52	**0.01**
Kuşkayası	3063±325.23	3291±119.89	3003±190.68	2437±231.35	0.20
Kızılören	631,92c±96.53	661,24c±89.37	1132b±204.58	1409a±202.89	**0.01**
Böğrüdelik	847,09±121.72	973,38±87.49	1100±62.2	1129±119.04	0.06
Mean± $S_{\bar{x}}$	1869±135.40	1644±117.58	1800±122.86	1704±88.59	0.19
Dry herbage yield					
	Budding	**10% flowering**	**50% flowering**	**Seedpod**	**p**
Boğazdere	639.32±59.07	521.04±25.45	514.79±32.55	630.56±47.32	0.06
Çevirme	431.88±40.57	418.08±23.07	340.13±50.42	382.16±39.08	0.39
Altınyayla	384.39±46.03	393.18±60.13	395.14±53.49	426.32±36.87	0.89
Kocakurt	594.62±23.61	473.78±49.87	763.13±53.07	571.49±50.79	0.05
Kuşkayası	591.24±58.53	719.52±24.34	755.95±55.64	588.76±57.00	0.08
Kızılören	166.46b±23.81	178.01b±23.01	311.51a±56.36	414.60a±57.76	**0.03**
Böğrüdelik	246.05b±30.58	258.52b±22.57	318a±16.70	365.91a±33.54	**0.05**
Mean± $S_{\bar{x}}$	436.28±27.50	423.16±25.51	485.52±30.13	482.83±21.65	0.80
	Budding	**10% flowering**	**50% flowering**	**Seedpod**	**p**
CP kg/decare	74.52±4.26	65.30±2.65	71.16±3.13	64.51±2.90	0.22
ME kg/decare	924.22±52.82	846.41±34.38	938.48±41.24	926.45±41.58	0.42

According to the harvest of dry herbage yield reported, respectively 333.50 kg, 629.20 kg, 815.20 kg, 1112.60 kg and 1020.90 kg. In the present study, herbage yield values were found higher in terms of budding and 10% flowering period. However, there was a steady increase in the later harvest periods (Deniz et al., 2005). In the present study, there was no regular increase in green and hay yields due to the progress of the harvest period. The nutrient and energy contents of sainfoin varied depending on the harvest period. Dry matter yields of the trial

fields increased regularly as expected compared to the harvest period. But; dry matter yields were very close to each other due to the short time between budding and seedpod stage. There was a statistically significant difference between four different harvest periods within the scope of average of dry matter yield in trial fields ($p<0.05$) (Table 3). From beginning of budding to seedpod period, respectively 24.70%, 26.60%, 27.67% and 29.03% dry matter values were obtained. But, Deniz et al (2005) in their study budding, 25%, 50%, 100% flowering and seedpod periods, respectively 11.65%, 17.39%, 23.49%, 28.96% and 30.59% reported dry matter yields. It was natural that different and higher dry matter values were obtained from the present study due to differences between the study data and the current study data in the selected periods and the sampling time being 35 days in total and the drying of green herbage in the field. The crude protein decreased as expected due to the progress of the harvest period. In this decrease, the ripening of the plant and the leaf/ stem ratio are the factors. According to the 2017 years weather data shown in Table 2, the rainfall in the 5th month has decreased by half in the 6th month and temperatures increased by 5-6 degrees. However, especially according to the increasing temperature and data for many years. In 2017, due to the lower total rainfall, rapid flowering and subsequent seedpod were observed.

Table 4. Nutrient content of sainfoin collected from trial fields in four different harvest periods (% DM)

	Budding	10% flowering	50% flowering	Seedpod	
	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	p
Dry matter, %	24.70c±0.86	26.60b±0.49	27.67ab±0.80	29.03a±0.78	**0.001**
Crude protein, %	16.53a±0.23	15.43b±1.09	15.09b±0.17	13.30c±0.17	**0.001**
Crude fat, %	2.14a±0.05	2.09a±0.20	1.94ab±0.06	1.72b±0.05	**0.001**
Crude ash, %	7.72a±0.15	6.78bc±0.96	7.40ab±0.15	6.72c±0.10	**0.001**
NDF%	35.87b±0.53	38.37b±3.81	40.47a±0.76	41.33a±0.66	**0.001**
ADF%	33.49c±0.60	36.48b±3.68	36.91bc±0.70	38.33ab±0.63	**0.001**
NFC%	37.74ab±0.50	37.33a±3.19	35.10b±0.73	36.94ab±0.58	**0.001**
Lignin%	9.37ab±0.46	10.25ab±0.94	9.45b±0.37	11.04a±0.17	**0.001**
NDICP%	3.030a±0.08	2.55b±0.53	2.32bc±0.16	1.38d±0.05	**0.001**
ADICP%	2.61a±0.15	2.99a±0.58	2.63a±0.08	2.15b±0.07	**0.001**
A Frak. %CP	21.19±1.23	21.77±3.74	18.55±1.24	18.81±0.73	0.08
B Frak. %CP	62.73ab±1.56	58.07b±3.37	63.93a±0.78	65.37a±0.67	**0.02**
C Frak. %CP	16.08ab±1.15	19.45ab±4.03	17.52ab±1.03	16.19b±0.60	**0.001**
RUP 2%	35.51a±0.64	34.26a±2.75	34.16a±0.65	31.44b±0.38	**0.001**
RUP 4%	38.67a±0.67	37.41a±2.66	37,58a±0.61	35.11b±0.39	**0.001**
RUP Dig., %	62.29b±0.35	61.81b±1.46	62.86b±0.21	64.37a±0.20	**0.001**
DE-1X, Mcal/kg	2.68a±0.03	2.59a±0.08	2.57ab±0.03	2.48b±0.02	**0.001**
ME-3X, Mcal/kg	2.05a±0.02	2.00a±0.07	1.99a±0.02	1.91b±0.01	**0.001**
NEL-3X, Mcal/kg	1.25a±0.01	1.21a±0.05	1.20a±0.02	1.14b±0.01	**0.001**
NEL-4X, Mcal/kg	1.19a±0.01	1.16a±0.04	1.15a±0.01	1.10b±0.01	**0.001**
NEM-3X, Mcal/kg	1.24a±0.02	1.19a±0.07	1.17a±0.02	1.09b±0.01	**0.001**
NEG-3X, Mcal/kg	0.65a±0.02	0.61a±0.06	0.60a±0.02	0.52b±0.01	**0.001**

The number of days that the sainfoin remained in the flower showed a rapid course due to low rainfall and high temperature. In terms of crude protein value, the average data of the

experimental fields showed a statistically significant difference between the periods according to the harvest periods (p=0.001). In budding, 10% flowering, 50% flowering and seedpod periods crude protein were determined respectively 16.53%, 15.43%, 15.09% and 13.30%. Deniz et al. (2005) at the beginning of budding, 25%, 50%, 100% flowering and seedpod periods has, respectively, 21.62%, 16.06%, 12.35%, 12.31% and 11.60% the crude protein values. In the study of Deniz et al. (2005), because of the low dry matter content at the budding, higher crude protein value was obtained and seedpod period was obtained with higher dry matter content and lower crude protein values. For this reason, the current study does not agree with the findings of Deniz et al. (2005). Bal et al. (2006), crude protein values in the beginning of flowering, flowering and seedpod periods, respectively found 19.50%, 14.50% and 13.05%. The findings of the present study were consistent only with the seeding period. Kaplan et al. (2014) in their study before flowering, flowering and seedpod periods, respectively, found 17.43%, 15.67% and 13.06% crude protein content. These values were similar to those in the present study. The fact that the data in the literature are not the same in the current study are directly related to the harvest period. It cannot be expected that the nutrient contents of the plants that are not harvested in the same period and are not in the same climate zone are similar. As shown in Table 4 in terms of crude ash, was found statistically significant difference between different harvest periods according to the average data of trial fields ($p<0.05$). Budding, 10% flowering, 50% flowering and seedpod periods, respectively 7.72%, 6.78%, 7.44% and 6.72% crude ash were found. The reason for the decrease in the crude ash content from budding to the 10% flowering period is unknown but showed some increase in the 50% flowering period and generally tended to decrease. This decrease was attributed to the decrease of inorganic material and the increase of organic material. Bal et al. (2006) reported that the rate of crude ash in sainfoin dry herbages was 8.31%, 6.88% and 7.18% in different vegetation periods. These values correspond to the current study. Also; Deniz et al. (2005), in their study budding, 25%, 50%, 100% flowering and seedpod periods reported crude ash values 9.25%, 7.81%, 6.87%, 6.59% and 6.24% respectively. Deniz et al. (2005) determined that the rate of crude ash during budding is lower than the present study. Crude ash data in other periods were consistent with the present study. In terms of NDF and ADF parameters, statistically significant difference was found between different harvest periods according to the average data of the trial fields ($p<0.05$) (Table 4).

Table 5. Sampling dates of sainfoin green herbage at different harvest periods in trial fields

Field	Budding	10% flowering	50% flowering	Seedpod
Boğazdere	06.06.2017	07.06.2017	10.06.2017	20.06.2017
Çevirme	07.06.2017	11.06.2017	15.06.2017	20.06.2017
Altınyayla	06.06.2017	07.06.2017	10.06.2017	19.06.2017
Kocakurt	08.06.2017	08.06.2017	11.06.2017	19.06.2017
Kuşkayası	08.06.2017	11.06.2017	12.06.2017	19.06.2017
Kızılören	08.06.2017	09.06.2017	12.06.2017	20.06.2017
Böğrüdelik	09.06.2017	09.06.2017	15.06.2017	20.06.2017

According to the sainfoin harvest period, NDF values were 35.87%, 38.37%, 40.47% and 41.33%. It has an ADF value of 33.49%, 36.48%, 36.91% and 38.33%.NDF and ADF values increased as expected in parallel with the harvest period. The highest NDF and ADF values were obtained during the seedpod period and this was due to the increase in fiber content of the plant. Although the NDF ratio is lower than the ADF ratio, they both increase due to the delay of the harvest period. Bal et al. (2006); carried out analyses during the beginning of flowering, flowering and seedpod periods. In this context; NDF contents were reported as 46.14%, 49.27% and 55.71%, and ADF contents were reported as 33.40%,

37.21% and 40.15%, respectively. Deniz et al (2005) in their study budding, 25%, 50%, 100% flowering and seedpod periods 40.12%, 48.38%, 52.31%, 52.03% and 55.38% have NDF respectively; they also detected 29.72%, 37.92%, 41.71%, 40.39% and 44.22% of ADF. Values in the present study; It is lower than the values determined by Deniz et al. (2005) and Bal et al. (2006). This may be attributed to the early completion of the vegetation of the plant. The plant binded seed after flowering in 10-15 days. In the present study, a statistically significant difference was found between seven different trial fields in terms of condensed tannin parameter and between different harvest periods according to the average data of trial fields ($p < 0.05$). According to the data in Table 6, there are 4.42% extractable condensed tannin values at budding, 4.92% at 10% flowering, 5.93% at 50% flowering and 7.59% at seedpod stage. According to the data obtained from Meteorology data information system (MEVBİS) it was observed that the plant tied the seeds quickly due to the low rainfall in the four districts where the study was carried out according to the temperature and precipitation data for 2016-2017 and the average temperature was above the seasonal norms (Table 2). In the light of these data, it was observed that condensed tannin increased. Multiple analyses were performed to confirm this data. Similar results were obtained in these analyses. As the harvest period progresses, the amount of condensed tannins should decrease. But in the present study, the amount of condensed tannins did not decrease due to the ripening of the plant. Condensed tannin increased from the beginning of the harvest period to the end. The flower color darkened from the beginning of flowering to the seedpod period and the contrast observed in the analysis increased. It increased spectrophotometric absorption with increasing contrast and consequently the amount of phenolic (condensed tannin) was high. The fact that the plant's crude protein content does not decrease significantly despite the progression of the harvest period may also mean that the phenolic phase is not completed. Bal et al. (2006), sainfoin on the beginning of flowering, flowering and seedpod periods in the condensed tannin content 10.51%, 6.96% and 4.26% have been reported respectively. Azuhnwii et al. (2013) for sainfoin during early flowering in their study 41-85 g; Wang et al. (2008) 43.60-61.80 g; Berard et al. (2011) found 16.30-94.40 g of condensed tannins. For the flowering period Kaplan (2011), 41.90-99.50 g; Azuhnwi et al. (2013) 46.90-68.70 g; Lorenz et al. (2010) reported that it contains 32.20-42.40 g extractable condensed tannin. The values in the present study are consistent with the data of Azuhnwi et al. (2013), although the harvest period is not known. In general, the increase in the rate of condensed tannin from budding to seedpod period is not consistent with the present study.

Table 6. Condensed tannin ratio according to trial fields and harvest period (% DM)

	Budding	10% flowering	50% flowering	Seedpod	
Field	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	**p**
Boğazdere	3.18c± 0.02	4.46b±0.02	4.03b±0.03	8.07a±0.01	**0.001**
Çevirme	3.95d±0.03	5.11c±0.13	6.62b±0.02	7.39a±0.01	**0.001**
Altınyayla	4.95d±0.03	5.86c±0.05	9.20b±0.03	9.48a±0.01	**0.001**
Kocakurt	4.42a±0.01	4.34b±0.01	2.94c±0.01	4.33b±0.01	**0.001**
Kuşkayası	2.37c±0.01	3.32b±0.03	2.53c±0.01	6.58a±0.01	**0.001**
Kızılören	5.82d±0.02	6.46c±0.08	9.10a±0.03	8.49b±0.02	**0.001**
Böğrüdelik	6.23c±0.03	4.93d±0.02	7.08b±0.02	8.84a±0.27	**0.001**
Mean±SE	4.42c±0.25	4.92c±0.19	5.93b±0.50	7.59a±0.31	**0.001**

CONCLUSIONS

Sainfoin, the most sown forage plant after alfalfa, silage maize, vetch and oats, is a source of roughage. In this study, feed value was determined by sampling the sainfoin plant from four different harvesting periods in seven different villages in 4 different districts in Sivas. The following important results were noted. The sainfoin plant grows mainly in winter and spring rainfall. In 2016-2017 years when the meteorological data given in Table 2 was examined, a very dry autumn, winter and spring were observed in the experiment fields.

The amount of precipitation in the districts of Ulaş, Altınyayla, Kangal and Gürün, where the plant was fed from September 2016 to June 2017, was respectively 281.70, 267.60, 194.20 and 205.60 mm. In other words, the rainfall in the districts decreased by almost half. Inadequate precipitation affected the yield, disrupted homogeneity in the fields, and it was not possible to make a healthy sampling. During the sampling process, low rainfall and hot weather caused the harvest times to progress rapidly. Therefore, in dry years, harvest time must be followed carefully. In seven different sainfoin fields in different districts where harvesting times are given, the difference between budding time and seedpod time harvests is 11-14 days (Table 5).

During the sampling process, low rainfall and hot weather caused the harvest times to progress rapidly. Therefore, in dry years, harvest time must be followed carefully. Depending on the ripening process of the plant, energy and nutrient contents decreased as expected.

The most significant decrease occurred during the seedpod period. For this reason, it is important to preserve the roughage quality before the seeding period. There was no statistically significant difference between the amounts of metabolic energy and protein obtained from decare ($p>0.05$). If it is wanted to be emphasized, it can be said that it will be more beneficial to make an early harvest considering the quality of the product, since there will not be a significant change depending on the harvest time in dry conditions. In contrast to the data obtained from many sources, the concentration of condensed tannin contained in the sainfoin as bioactive material increased, probably with the effect of drought, with the progress of harvest time.

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