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**Changing of Cell Wall Fractions of Kermes Oak (*Quercus coccifera* L.) in a Vegetation Period and theirs Importance for Pure Hair Goat (*Capra hircus* L.) Breeding in West Mediterranean Region of Turkey**

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**Abstract:** This study was investigated the change occurring depending on the vegetation period in the Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL), cellulose (CE) and hemicellulose (HEM) of feed fiber characteristics in samples taken in five periods from kermes oak (*Quercus coccifera* L.). According to the results of the research, the values obtained in the analysis conducted on the dry matter based the samples taken on May 15, June 15, July 15, August 15 and September 15, 2008 have been as follows: NDF values - 44.36, 56.05, 58.58, 59.83 and 60.71%; ADF values - 31.14, 39.94, 43.24, 47.49 and 48.03%; ADL values - 14.07, 19.37, 20.02, 24.33 and 24.35%; CE values - 17.06, 20.57, 23.22, 23.16 and 23.68% and HEM values - 13.22, 16.10, 15.33, 12.67 and 12.67% ( $p < 0.05$ ). The period when the kermes oak is best in terms of the quality of the feed is the month of June because the quality of the feed increases along with the increase in the NDF value.

**Key words:** Kermes oak, cell wall fractions, dietary fiber, neutral detergent fiber, feed quality

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## INTRODUCTION

The forestry policies applied in Turkey aim to reduce and even eliminate breeding pure hair goats on the grounds that this harms forests (GDF, 1984). This policy has achieved its purpose up to a certain degree and the number of pure hair goats which was 15 million in 1975, was reduced to 6 million in 2008 (TUIK, 2008).

The areas in Turkey where pure hair goat breeding is most widely conducted are the Aegean, Mediterranean and Southeast Anatolian Regions. Nomads who live in these areas have been breeding pure hair goats in the upper basins of that region for centuries (Boyazoglu *et al.*, 2005; Ocak *et al.*, 2007). Pure hair goat breeding symbolizes a cultural value for nomads, in addition to being a breeding system (Guney and Darcan, 2005).

There are similarities between the borders of the regions where pure hair goats are bred and natural distribution borders of some types of trees and shrubs within the Mediterranean scrub vegetation. Shrub vegetation occupies a great part of the territory of the country and the kermes oak (*Quercus coccifera* L.) which is a sclerophyllous shrub, is the dominant species in these shrublands. The kermes oak shrublands are browse range-lands, covering more than 2.4 million ha. Although the forest law bans the entry of goats into the forests, the villagers use these areas for grazing purposes. Goat husbandry and to some extent sheep husbandry, depends on both browse and herbage produced by kermes oak scrubland.

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The Ministry of Environment and Forestry has prepared the action plan for reducing damage caused by goats in 2008. The government has adopted a very radical decision with this action plan. According to the referred decision, in areas with no erosion risk, that are not suitable for forestation and the breeding of productive forests, with no risk for floods and inundation and are suitable for raising goats due the vegetation, villagers will be allowed to raise pure hair goats (MEFO, 2008).

Various researches have been conducted regarding grazing at in-forest meadows and forage yield in Turkey (Defne, 1955; Alpay, 1972). Furthermore, there are also researches regarding utilization of leaf fodders of forest trees (Mol, 1982; Sevimsoy and Sun, 1987). In these researches, the damage made by pure hair goats on the forest and the trees have been highlighted and request has been made for keeping them away from forests. Yet, in the countries located in the Mediterranean Region have noticed the importance of the kermes oak (*Quercus coccifera* L.), boz pinal oak (*Quercus aucheri* Jaub. and Spach.) and holm oak (*Quercus ilex* L.) in goat breeding and tried to develop their breeding system (Papachristou, 1997; Aldezabal and Garin, 2000; Boyazoglu and Morand-Fehr, 2001; Ainalis and Tsiouvaras, 2004; Ainalis *et al.*, 2006; Zarovali *et al.*, 2007; Boubaker *et al.*, 2007).

In Turkey, kermes oak is a type of shrub to which no value is placed by foresters on the grounds that it cannot form a productive forest. Therefore, this type of shrub is only known by academia due to its general botanical characteristics. Although shoots and leaves provide a major feed input in breeding pure hair goat (*Capra hircus* L.), their nutrient composition and quality are not known.

This study was investigated the change in the vegetation period of Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL), Cellulose (CE) and Hemicellulose (HEM) as cell wall fractions of the kermes oak.

## MATERIALS AND METHODS

### Study Area

This study was conducted at Süleyman Demirel University, Research and Implementation Forest Areas, in Isparta Province, Western Mediterranean Region of Turkey. The study area is located between 37°83'50"-37°83'31" north latitude and 30°51'72-30°51'94" east longitude and has an elevation of 1250 m. Its slope is to the southwest.

According to data provided by Isparta Meteorology Station, the long-term average annual rainfall is 600.4 mm and the average air temperature is 12.1°C. During the winter (December-March) and summer (June-September) seasons, the average air temperature ranges from 1.7-5.8°C and 19.7-23.1°C and the average rainfall ranges from 90.0-100.0 mm and 9.6-36.6 mm, respectively. The climate of the area is characterized as semi-arid and cold winters. The soil texture is clay to wet clay, derived from conglomerates of the mesozoic period and colluvials from river or torrent bank deposits (Atalay, 2006). A range of organic matter content between 2.60-3.20% and a pH (7.5) are both considered average.

The shrub variety that shows a native range within the study area is kermes oak. The land coverage rate of kermes oak ranges between 70 and 90% and the shrub height ranges between 50 and 150 cm.

### Experimental Methodology

An area of 3 ha was selected within the university research forest with the same growth environment and site characteristics (aspect, elevation, slope, soil, etc.). Within this area, kermes oak shrubs that have spread over an area of at least 6 m<sup>2</sup> were identified and 30 shrubs with this characteristic were selected at random. A sampling quadron of 1×1 m was created by using wooden slats. Representative, hand-plucked forage samples (Cook, 1964) similar to those consumed by animals were collected. Samples from the study area were collected on May 15, June 15, July 15, August 15 and September 15, 2008.

In order to determine the dry matter content ratios, 30 herbage samples obtained at each period were mixed into a single sample and were grounded in a hummer mill with a sieve hole diameter of 3 mm. All samples were oven-dried at 105°C for 24 h and weighed. Therefore, the dry matter contents of the samples were determined as a percentage ratio.

Dry matter samples were used in designating cell wall fractions. Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL) analysis were conducted according to the method reported by Van Soest *et al.* (1991). Cellulose (CE) and Hemicellulose (HEM) values were calculated according to the results of this analysis. (Cellulose = ADF-ADL and Hemicellulose = NDF-ADF). These procedures were conducted in the laboratory separately at each period as 3 parallel and 4 recurrent analysis.

**Statistical Analysis**

All data sets were subjected to repeated measurements ANOVA in order to test statistical significance across the five periods. The Tukey test was applied in order to test statistical differences between means (Steel and Torrie, 1980). The statistical analysis were carried out using SPSS 16.0 software for Windows. All tests were performed at the level of significance of  $p < 0.05$ .

**RESULTS**

Results of ANOVA on Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL), Cellulose (CE) and Hemicellulose (CE) are shown in Table 1. Differences between period means as a result of variance analysis are statistically significant.

**Neutral Detergent Fiber (NDF)**

After the beginning of the vegetation period (vegetation period begun in mid of March) the first biomass sample from the kermes oak was taken in May 15. In the samples taken on this date, the NDF value was 44.36%. In the period June 15, a severe increase took place in the NDF figure, reaching 56.05%. The increase in the NDF rate continued until July 15 and the NDF value was found as 58.58% as a result of the analysis conducted. The NDF value for the period August 15 was 59.83% ( $p < 0.05$ ). No significant increase occurred in the NDF figure on September 15, which followed the period August 15 ( $p > 0.05$ ).

Table 1: Changing of cell wall fractions of kermes oak (*Quercus coccifera* L.) in a vegetation period

Date	DM (%)	DM basis (%)					
		NDF		ADF		ADL	
		Min.-Max.	Mean±SD	Min.-Max.	Mean±SD	Min.-Max.	Mean±SD
May 15, 2008	43.26	43.92-44.81	44.36±0.44 <sup>d1</sup>	31.07-31.22	31.14±0.07 <sup>d</sup>	13.97-14.18	14.07±0.10 <sup>e</sup>
June 15, 2008	53.83	55.82-56.28	56.05±0.23 <sup>c</sup>	39.87-40.01	39.94±0.07 <sup>c</sup>	19.05-19.69	19.37±0.32 <sup>b</sup>
July 15, 2008	56.85	58.27-58.89	58.58±0.31 <sup>b</sup>	42.93-43.56	43.24±0.31 <sup>b</sup>	19.87-20.17	20.02±0.15 <sup>b</sup>
Aug. 15, 2008	57.35	59.39-60.14	59.83±0.39 <sup>a</sup>	46.97-48.01	47.49±0.52 <sup>a</sup>	23.96-24.70	24.33±0.37 <sup>a</sup>
Sept. 15, 2008	57.95	60.38-60.89	60.71±0.28 <sup>a</sup>	48.03-48.04	48.03±0.00 <sup>a</sup>	24.21-24.50	24.35±0.14 <sup>a</sup>

  

Date	DM (%)	DM basis (%)			
		CE		HEM	
		Min.-Max.	Mean±SD	Min.-Max.	Mean±SD
May 15, 2008	43.26	16.89-17.25	17.06±0.18 <sup>c</sup>	12.70-13.74	13.22±0.52 <sup>b</sup>
June 15, 2008	53.83	20.32-20.82	20.57±0.25 <sup>b</sup>	15.81-16.41	16.10±0.30 <sup>a</sup>
July 15, 2008	56.85	23.06-23.39	23.22±0.16 <sup>a</sup>	14.71-15.96	15.33±0.62 <sup>a</sup>
Aug. 15, 2008	57.35	22.27-23.16	23.16±0.89 <sup>a</sup>	12.38-12.99	12.67±0.30 <sup>b</sup>
Sept. 15, 2008	57.95	23.54-23.82	23.68±0.14 <sup>a</sup>	12.34-12.85	12.67±0.28 <sup>b</sup>

DM: Dry Matter, NDF: Neutral Detergent Fiber, ADF: Acid Detergent Fiber, ADL: Acid Detergent Lignin, CE: Cellulose, HEM: Hemicellulose, SD: Standard Deviation. <sup>1</sup>Means in the same column followed by the same letter(s) are not significantly different at the 0.05 level

#### **Acid Detergent Fiber (ADF)**

The ADF value of the dry matter obtained from herbage samples taken on May 15 in the measurements conducted in the first period as of the beginning of the vegetation period was found as 31.14%. On June 15, the biggest increase was achieved in 1-month periods, reaching the value 39.94%. In the next sample taking period, which was July 15, the ADF value was 43.24%. In the analysis conducted in the period August 15, the ADF value 47.49% ( $p < 0.05$ ). In the analysis conducted on September 15, the no considerable increase was achieved in the ADF value ( $p > 0.05$ ).

#### **Acid Detergent Lignin (ADL)**

The ADL value in the samples taken on May 15 was found as 14.07%. On June 15, this figure achieved its increase reaching 19.37%. The ADL value on July 15 was 20.02%, whereas the ADL value on August 15 was 24.33% ( $p < 0.05$ ). The results of the analysis conducted on September 15, did not display any statistical difference compared to August 15 ( $p > 0.05$ ).

#### **Cellulose (CE)**

In the dry matter obtained from the biomass samples taken on May 15, the cellulose value was found as 17.06%. This rate increased on June 15 and July 15, reaching the values 20.57% and 23.22% respectively ( $p < 0.05$ ). The results of the analysis conducted on the samples taken on August 15 and September 15 were 23.16% and 23.68%, respectively, with no difference between these two periods compared to July 15 ( $p > 0.05$ ).

#### **Hemicellulose (HEM)**

On May 15, the hemicellulose value on the dry matter basis was found as 13.22%. This value reached the figure 16.10% by achieving its highest rate among different periods on June 15. In the analysis conducted on the samples taken on July 15, the hemicellulose rate was found as 15.33%. In the analysis conducted on August 15, the hemicellulose value was found as 12.67%, the hemicellulose value began to drop compared to last periods ( $p < 0.05$ ). As a result of the analysis conducted on September 15, did not display any difference compared to August 15 ( $p > 0.05$ ).

### **DISCUSSION**

The Neutral Detergent Fiber (NDF) refers to the amount of hemicellulose, cellulose, lignin, cutine and insoluble protein contained within the structure of the plant cell wall. The NDF rate is an indicator of the growth status or maturity of the plant. The NDF value is a key indicator in the nutrition of the animals and the high NDF value means the low quality of the feed. The Acid Detergent Fiber (ADF) refers to the amount of cellulose, lignin and insoluble protein contained within the structure of the plant cell wall. The high rate of ADF in a feed is the low digestibility (Gorgulu, 2002). Ruminants may break down the hemicellulose and cellulose which are insoluble carbohydrate parts contained within the plant cell wall but they cannot break down acid detergent lignin (Ergul, 2008). When these remarks are considered in respect of the results of the survey, it may be observed that the months May and June are the periods when the quality of the feed is at the highest degree in the kermes oak. The month of May is the period when the growth of the leaves and shoots of this type of shrub takes place at the highest rate and blooming and pollination also occur. Therefore, they should not be used during this period. The month of June is the period when maximum benefit may be obtained from the kermes oak both qualitatively and quantitatively.

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