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# VOLATILE FATTY ACIDS AND FATTY ACID COMPOSITION OF SILAGE SPECIES

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***Abstract***

*In this study, total fatty acid composition and volatile fatty acid of silage species in Turkey was determined by using Gas Chromatography (Shimadzu 15-A). Total lipids were extracted from the corn silage, alfalfa silage and figüre silage samples by the method of Folch et al. Silage species were a total of 15 different fatty acids. These fatty acids between C12 to C24 have changed. Unsaturated fatty acids were the most corn silage. Linoleic acid levels were at the highest levels in alfalfa silage. In this study, unsaturated fatty acid is higher saturated fatty acid. ω6/ω3 ratio is 6. This value is high. In the report of HMSO, it was suggested that the minimum ratio of PUFA/SFA should be 0.45. In this study this value is 2. According to this result, oil of seed of corn silage is healthy.*

***Key words****: Fatty acid composition, Silage species, Volatile fatty acid.*

## INTRODUCTION

Silage, forage rich in terms of water, concrete, stone, wood or plastic material, leaving a vacuum in the activity of lactic acid bacteria in the prepared feed silo container is obtained by fermenting. So there is a kind of pickles made from rich fodder for the animals in terms of water.

In recent years, our country has increased rapidly create silage and corn silage produced more than about 80% of the total silage (Alçiçek and Karaayvaz, 2003). An important part of the silo feed produced in our country is used for feeding dairy cows, while a small portion is used in beef cattle (Yaylak and Alçiçek, 2003). Corn silage, which should include both energy and lovingly consumed by animals because of silage fodder plants 'best of' bears the distinction of being (DLG, 1997). The feed value of corn silage should be used in both the production costs of intensive feeding animals considered to be spread throughout the country and is a must.

Corn silage is an important dietary source of fatty acids for ruminant breeding animals in Turkey. The fermentation quality of silages has a major effect on feed intake, nutrient utilization and milk production of ruminants (Huhtanen et al., 2002, 2003). Fresh whole corn silage dry matter which generally contains 30-40% grains is rich in linoleic acid and oleic acid and poor in α-linolenic acid, <2% (Chilliard et al., 2007). Concentrations of ALA vary with plant and environmental factors such as stage of maturity, genetic differences, as well as season and light intensity (Elgersma et al., 2006).

## MATERIALS AND METHODS

Sample collection

Corn silage, alfalfa silage and figure silage samples, used in this study, were obtained from Konya, Turkey. In the present study, the laboratory chosen for analysis were in 2014. The samples were collected of each season during 2013. The samples were frozen at -26ºC until analyzed. At the beginning of analysis, the samples were allowed to equilibrate to room temperature.

Fatty acid analysis

A water extract of silage was prepared by adding deionised water to 20 g of silage to

achieve a total of 200 g. The values of pH, organic acids lactic acid and volatile fatty acids (VFA: acetic, propionic, n-butyric acids) - were analysed by the method of Naumann and Bassler (1997). The fatty acids in corn silages were determined in lyophilized samples. Lipids from freeze-dried corn and corn silages were extracted using an extraction-transesterification procedure described by Sukhija and Palmquist (1988). A mixture of chloroform and methanol (2:1) was chosen as the extraction solvent. In the extraction of fatty acids from the silages studied, the basic method of Folch, Lees, & Stanley, (1957). For this, samples were homogenized in a chloroform/methanol (2/1, v/v) mixture. The method of AOCS (1972) was employed in order to obtain the methyl esters of fatty acids by using BF3 (14%). The extracted lipids were dissolved in 1mL hexane with internal standard C13:0 and the esterification of lipids was carried out with 2 ml N sodium metoxide (30 min, 50°C) and 3 ml 3 N methanolic HCl (60 min, 50°C). After centrifugation (5 min, 2,500 rpm), samples of the upper hexane layers were used for gas chromatographic analyses. GC analysis of the methyl esters was performed using a GC Shimadzu 15-A model gas chromatograph (GC), equipped with a flame ionization detector (FID) and and a 1.8 m × 3 mm internal diameter packed glass column containing 100/120 Chromosorb WAW coated with 10% SP 2330. Injector and detector temperatures were 225 and 245 ºC, respectively. Column temperature program was 190 oC for 45 min then increasing at 30$^{o}$C/min up to 220$^{o}$C where it was maintained for 5 min. Total run time was 51 min. Carrier gas used was nitrogen (1 ml/min).

Identification of fatty acids was carried out by comparing sample FAME peak relative retention times with those obtained for Alltech (Carolean Industrial Drive, Satate Collage, PA) standards. Results were expressed as FID response area relative percentages. Each reported result is the average value of three GC analyses. The results are offered as mean ± SD in Table 1.

Statistical analysis

Each reported result is the average value of three GC analyses. The results were given as means and standard deviations (±SD). Statistical analyses were performed by using SPSS 16.0 software, and multiple comparison tests were carried out. The results were submitted to analysis of variance (ANOVA), at 0.05 significance level, using SPSS 16.0. The mean values were compared by Duncan test.

## RESULTS AND DISCUSSIONS

Fatty acid composition of silage are presented in Table 1.

Table 1. Fatty acid composition of corn silage in Turkey

| **Fatty acids** | **%** |
|---|---|
| C 10:0 | 0,04 |
| C 12:0 | 0,3 |
| C 13:0 | 0,06 |
| C 14:0 | 1,29 |
| C 15:0 | 0,33 |
| C 16:0 | 17,12 |
| C 17:0 | 0,02 |
| C 18:0 | 7,67 |
| C 20:0 | 0,21 |
| C 21:0 | 0,01 |
| C 24:0 | 0,03 |
| ∑ **Doymuş** | **27,08** |
| | |
| C 14:1 | 0,28 |
| C 16:1 | 1,08 |
| C 16:1-T | 0,01 |
| C 18:1 | 27,64 |
| C 20:1 | 0,29 |
| C 22:1 | 0,06 |
| ∑ **MUFA** | **29,36** |
| | |
| C 16:2 | 0,01 |
| C 18:2 | 37,55 |
| C 18:3 | 5,39 |
| C 20:3 | 0,07 |
| C 22:2 | 0,23 |
| C 22:3 | 0,07 |
| C 22:4 | 0,23 |
| C 22:6 | 0,01 |
| ∑ **PUFA** | **43,56** |
| | |
| ∑ Doymamış | 72,92 |
| ∑ PUFA / MUFA | 1,48 |
| ∑ Omega 3 | 5,54 |
| ∑ Omega 6 | 38,01 |
| ∑ Omega 3/6 | 0,15 |
| ∑ Doymuş/Pufa | 0,62 |

We found 25 fatty acids in corn silage. The highest fatty acids in corn silage were found to be 18:2, 18:1, 16:0, 18:0, 18:3, 14:0, 16:1. C8:0 was not found in corn silage. C10:0, C11:0, C12:0, C13:0 were found to be low in the SFA fractions of the silage investigated. Palmitic acid (C16:0) was the primary major SFA (about 17.12). Stearic acid (C18:0) was the seconder major SFA (about 7.67)

Oleic acid (C18:1 n9) was identified as a primary monounsaturated fatty acid (MUFA) in the corn silage for all samples. This fatty acid in corn silage was found to be at levels of about 27.64% in all samples. The highest level of MUFA was oleic acid. According to Cherfaoui et al. (2013), oleic acid is the major monounsaturated fatty acid in other silage species.

Saturated fatty acids were lower than total monounsaturated fatty acids. The ratio of total SFAs was 27.08%. Linoleic acid was the primary polyunsaturated fatty acid, 37.55% for corn silage in all samples. In corn silage, a high amount of linoleic acid and linolenic acid increased the PUFA content in all samples. In our study, total SFA were affected by palmitic acid and stearic acid amount in corn silage. Linoleic acid was major fatty acid in corn silage. Other predominant fatty acids were oleic acid (27.64%) and palmitic acid (17.12%). In this study, DHA, which was recorded in silage to be 0.01%, was observed to be the minör polyunsaturated fatty acid.

In this study, corn silage was rich in PUFA, especially linoleic acid, and other predominant PUFA were linolenic acid in all samples. These results agree with Lauková et al. (2009), who have reported that linoleic acid, linolenic acid and DHA the most abundant PUFA in corn silage lipids in Konya, Turkey. In a previous study, linoleic acid, linolenic acid, DHA, were most abundant PUFA in corn silage in all samples (Han et al., 2013). In our study, total PUFA was higher than total MUFA in corn silage. DHA were low level. These results agree with Arvidsson et al., 2009 who has reported that PUFA is higher than total SFA and total MUFA in corn silage.

The results in the present work indicate that the n-3/n-6 ratio of corn silage is lower in all samples 0.15%. The present study indicates that corn silage are good in terms of n-6/n-3. The n-6/n-3 ratio is a good index for comparing relative nutritional value in corn silage. An increase in the human dietary n-6/n-3 fatty acid ratio is essential to help prevent coronary heart disease by reducing plasma lipids (Gokce et al., 2004).

## CONCLUSIONS

This study has revealed that corn silage in the Konya of Turkey is a desirable item in the diet when the levels of linoleic acid and n-6/n-3 ratio are considered. The corn silage identified in this study was found to be good source of n-6 fatty acids.

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