Journal of Animal and Veterinary Advances 6 (2): 217-219, 2007

Effect of Wheat Straw and Different Additives on Silage Quality and *In vitro* Dry Matter Digestibility of Wet Orange Pulp

[1]N. Denek and [2]A. Can
[1]Faculty of Veterinary Medicine, University of Harran, Sanliurfa, Turkey
[2]Department of Animal Science, Faculty of Agriculture, University of Harran, Sanliurfa, Turkey

Abstract: This study was carried out to investigate effect of no additives (control) or 10% wheat straw, 10% wheat straw+0.5% urea, 10% wheat straw+5% molasses, 10% wheat straw+5% wheat grain, 10% wheat straw+0.5% urea+5% molasses and 10% wheat straw+0.5% urea+5% wheat grain (weight basis) on silage quality and in vitro dry matter digestibility of wet orange pulp. Contents of dry matter, crude protein, ADF, NDF, pH values *In vitro* dry matter digestibilities and fleig points of wet orange pulp were in range of 14.62-22.26, 7.62-14.17, 30.97-41.46, 51.02-56.22, 3.60-4.13, 51.58-80.62 and 81.85-101.73%, respectively ($p<0.05$). As a result, wet orange pulp can be ensiled well with or without additives, but addition 10% of wheat straw would be beneficial to eliminate negative effects related with the high moisture content of wet orange puple.

Key words: Wet orange pulp, silage, additive, *in vitro* digestibility, moisture content, crude protien

INTRODUCTION

Fruit pulp which is a byproduct of fruit juice, jam and marmalade and consists of fruit seed and peel and it is widely used in animal nutrition. Annually orange production of Turkey was 1.250.000 ton and 57% of total citrus fruits production. Ten percent of citrus production (125 000 ton) was processed for fruit juice, jam and marmalade in Turkey (DIE, 2002). When orange fruit is processed for orange juice product, around 45-60% of it is remained as a pulp in forms of peel, rag and seeds. It was reported that orange pulp has high nutritional value(Guessous *et al*., 1989; Martinea and Medina, 1982) and it is rich in pectin and soluble carbohydrates thus dehydrated orange pulp is used in ruminant diets (Bhattacharya and Harb, 1973; Hadjipanayiotou and Luca, 1976). Additionally it is low in nitrogen (Lanza, 1982) and has similar characteristics with roughages (Ghedalia *et al*., 1989). Usage of fresh orange pulp has some disadvantages such as its production depends on season, low in dry matter content (15-20%) related with processing systems and high in sugar content causes spoiling, therefore it is used in animal feeding after dehydrating or ensiling processes. Dehydrating is not a cost effective process, but ensiling orange pulp has good fermentation and desired pH values (Bryant, 1973). Due to high moisture content of citrus pulp, ensiling losses are too high. Eliminating this problem, citrus pulp was ensiled to getter with 10-20% grass hay or straws or silage additives such as sorbic acid (Ashbell *et al*., 1988; Weinberg *et al*., 1989).

Aim of this study is to determine nutrient contents, silage quality and *In vitro* dry matter digestibility of orange pulp ensiled with wheat straw and different silage additives.

MATERIALS AND METHODS

Fresh orange pulp as a silage material was obtained from private orange juice company at Hatay city of Turkey. Silage materials were ensiled as 7 different treatments which were control (only orange pulp), 10% wheat straw as fed basis of pulp (10% S), 10% wheat straw+0.5% urea (10% S+0.5% U), 10% wheat straw+5% molasses (10% S+5% M), 10% wheat straw+5% wheat grain (10%S+5% W), 10% wheat straw+5% molasses+0.5% urea (10% S+5% M+0.5% U) and 10% wheat straw+5% wheat grain+0.5% urea (10%S+5% W+ 0.5% U). After sufficient mixing of each combination, mixture was packed tightly in 1 L jars with three replicates per treatments. The jars were opened after a fermentation of 60 days. Water extracts of fermented materials were prepared by homogenizing 25 g of wet material with 100 mL water in a blender at full speed for 5 min. The content

Corresponding Author: N. Denek, Faculty of Veterinary Medicine, University of Harran, Sanliurfa, Turkey,

was filtered through two layers of cheesecloth and filtrate was used to measure the pH level. The Fleig Points (FP) of the silages were calculated by the following equation reported by Kilic (1984).

Fleig Points* = 220+(2 x DM% - 15) – 40 x pH

*(Values between 85-100 very good quality, 60-80 good quality, 55-60 moderate quality, 25-40 satisfying quality,<20 worthless)

Silage samples and raw materials were dried at 65°C and ground (1 mm) and analyzed for DM, OM, ash and CP by procedure of AOAC (1990) NDF and ADF contents were measured according to the procedure of Goering and Van Soest(1970). *In vitro* Dry Matter Digestibility (IVDMD) of silages was determined according to the procedure described by Tilley and Terry (1963) as modified by Marten and Barnes (1980). Ruminal fluid inoculum was obtained from two rumen fistulated rams given alfalfa hay ad-libitum.

Experimental data were analyzed in a completely randomized design using GLM procedure of SAS (1985). The means were compared using Duncan mean comparison test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Effects of wheat straw and different additives on silage quality, *In vitro* dry matter digestibility and fleig points of wet orange pulp silages are shown in Table 1. All the additives containing silages had the higher DM content than control silage ($p<0.05$). While DM content of 10%, S+5% M+0.5% U treatment was highest with 22.26%, control group had the lowest DM content with 14.2% ($p<0.05$). All the straw containing silages had DM values in the DM ranges of good quality silages reported by Ergul (1993). These increments in DM content of silages are probably due to high DM contents of S, M, W and U. DM content of orange can be varied between 15 to 20% by differences among methods and pressure applied during processing stage of orange juice production.

Dry matter content of control treatment was found similar with reported by Itavo *et al.* (2000a) (14.62%) and lower values reported by Gohl (1978), (19.6%). Due to 20%S usage at work of Scerra *et al.* (2001) DM contents were higher than values of current study. While 10% S, 10% S+0.5% U and 10% S+5% M+0.5% U treatments were increased ADF contents of silages, 10%S+5% M treatment did not change ADF content of silage compared with control. In contrast, 10% S+5% W and 10% S+5% W+0.5% U treatment decreased the ADF value of silages ($p<0.05$). NDF values of silages were higher in 10% S and 10% S+0.5%U treatments, but other treatments did not change NDF contents compared with control silage ($p<0.05$). Wheat grain added silages had low or similar ADF or NDF contents due to probably lower ADF and NDF contents of wheat grain. In current study, determined ADF and NDF values (36.44 and 52.10% of control silage were found higher than values reported by Itavo *et al.* (2000, a, b) and Scerra *et al.* (2001).

While 10% S, 10% S+5% M and 10% S+5%W treatments decreased CP content, 10% S+5% U, 10% S+5% M +0.5% U and 10% S+5% W+0.5% U treatments increased the CP content of silages compared with control silage ($p<0.05$). In this study, addition of urea increased CP content of silages which is in an agreement with results of Lattemae *et al.* (1996). Crude protein content of control silage (10.10%) was found higher than values (7.70, 8.48, 9.09 and 8.47% of former researches (Gohl, 1978; Itawo *et al.*, 2000a, b; Scerra *et al.*, 2001), respectively. This variation at CP contents can be explained by differences among species of orange fruit, soil nutrient contents, methods and pressure applied during processing stage of orange juice production.

One of the main factors determines silage quality is pH value (Kiermeier and Renner, 1963). All the additives increased pH values of silages compared with value of control silage ($p<0.05$). All pH values of silages were in range of 3.60 and 4.13 which is similar with optimum values (3.8-4.2) for good quality silages. The pH values of 10% S+5% U, 10% S+5% M+0.5% U and 10% S+5% W+0.5% U were higher than other treatments ($p<0.05$). Increment of pH with addition of urea in silages can be explained with that urea decreases soluble carbohydrate content, increases CP content and ammonia formation in silage materials (Kilic, 1984).

Table 1: Effects of wheat straw and different additives on silage quality, *in vitro* dry matter digestibility and fleig points of wet orange pulp silages

Treatments	DM	Ash*	CP*	ADF*	NDF*	pH	IVDMD*	FP
Control (wet orange pulp)	14.62 ^{b}	6.19 ^{d}	10.10 ^{c}	36.44 ^{d}	52.10 ^{c}	3.60 ^{e}	80.62 ^{a}	90.25 ^{d}
10% S	21.03 ^{a}	7.05 ^{c}	7.62 ^{e}	39.89 ^{b}	56.22 ^{a}	3.63 ^{e}	57.25 ^{e}	101.73 ^{a}
10% S + 0.5%U	21.09 ^{a}	8.33 ^{b}	13.37 ^{b}	41.46 ^{a}	54.41 ^{b}	4.13 ^{a}	51.58 ^{d}	81.85 ^{e}
10% S + 5%M	21.15 ^{a}	9.09 ^{a}	8.91 ^{d}	36.50 ^{d}	51.69 ^{c}	3.77 ^{d}	64.98 ^{c}	96.63 ^{bc}
10% S + 5%W	22.02 ^{a}	7.40 ^{c}	9.12 ^{d}	30.97 ^{f}	51.47 ^{c}	3.73 ^{d}	65.65 ^{bc}	99.71 ^{ab}
10% S + 5%M +0.5%U	22.26 ^{a}	9.09 ^{a}	13.35 ^{b}	38.28 ^{c}	51.02 ^{c}	4.00 ^{b}	64.70 ^{c}	89.53 ^{d}
10% S + 5%W +0.5%U	22.00 ^{a}	7.35 ^{c}	14.17 ^{a}	34.60 ^{e}	51.45 ^{c}	3.87 ^{c}	67.88 ^{b}	94.34 ^{c}
SEM	0.46	0.18	0.23	0.36	0.45	0.03	0.75	1.33

a-f: Means with a column with unlike superscripts differ ($p<0.05$). *:% of dry matter.

Control silage had the highest IVDMD (80.62%) than other treatment silages ($p<0.05$). 10% S+ 0.5% U treatment had the lowest IVDMD value (51.58%) ($p<0.05$). 10% S+5% M, 10% S+5% M+0.5% U, 10% S+5% W and 10% S + 5% W + 0.5%U treatments had the better IVDMD values than 10%S treatment silage ($p<0.05$) which can be explained due to high IVDMD of wheat grain and molasses. In this study, IVDMD of control treatment were found lower that value (90.15%) reported by Itavo *et al.* (2000 a). All silages had the high quality fleig points in ranged from 81.75 to 101.73.

CONCLUSION

As a result, wet orange pulp can be ensiled well with or without additives, but addition 10% of wheat straw would be beneficial to eliminate negative effects related with the high moisture content of wet orange pulp. Usage of big silos and animal feeding trial with orange pulp silages ensiled with or without additives is advised in future studies for determining more accurate feeding value of wet orange pulp silage.

REFERENCES

Ashbell, G., Z.G. Weinberg and A. Azrieli, 1988. Effects of balanching on loss reduction in orange peel storage. J. Sci. Food Agric., 3: 195-201.

AOAC, 1990. Association of Official Analytical Chemists. Official Methods of Analysis. Vol. 1. (15th Edn.), AOAC, Arlington, VA.

Ben-Ghedalia, D., E. Yosef and J. Miron,1989. The effects of starch- and pectin-rich diets on quantitative aspects of digestion in sheep. Anim. Feed Sci. Tech., 24:289-298.

Bhattacharya, A.N. and M. Harb, 1973. Dried citrus pulp as a grain replacement for Awassi lambs. J. Anim. Sci., 36: 1175-1180.

Bryant, M.P., 1973. Nutritional requirements of the predominant rumen cellulotytic bacteria. Fed. Proceciering. Fed. Amn. Sci. Exp. Bio., 32: 1809-1813.

DIE., 2002. Devlet Istatistik Enstitusu verileri. Ankara.

Ergul, M., 1993. Yemler Bilgisi ve Teknolojisi. II. Baski. E.U.Z.F. Yayinlari No: 487. Ders Kitabi, Bornova, Izmir.

Gohl, B.I., 1978. Citrus by-products for animal feed. FAO. Anim. Prod. Health, 12: 41-44.

Goering, M.K. and P.J. Van Soest, 1970. Forage fibre analysis. Agricultural Handbook, No. 379. Agric. Res., U.S. Dept., Agric.

Guessous, F., N. Rihani, A. Kabbali and W.L. Johnson, 1989. Improving feeding system for sheep in a Mediterranean rainfed cereals/livestock area of Morocco. J. Anim. Sci., 67: 3080- 3086.

Hadjipanayiotou, M. and A. Louca, 1976. A note on the value of dried citrus pulp and grape marc for barley replacement in calf fattening diets. Anim. Prod., 23: 129-132.

Itavo, L.C.V., G.T. Santos, C.C. Jobim, T.V. Voltolini, K.P. Faria and C.C.B. Ferreira, 2000a. Compasiçao digestibilidade aparente da silagem de bagaço de laranja. Rev. Bras. Zootech., 29, 5: 1485-1490.

Itavo, L.C.V., G.T. Santos, C.C. Jobim, T.V. Voltolini, C.C.B. Ferreira, 2000b. Substituiçao da silagem de milho pela silagem do bagaço de laranja na Alimentaçao de vacas Leiteiras. Consumo, Produçao e Qualidade do Leite. Rev. Bras. Zootech., 29, 5: 1498-1503.

Kilic, A., 1984. Silo Yemi. Bilgehan Basimevi. Izmir.

Kiermeier, F. and E. Renner, 1963. Der pH-wert ais Kriterium der verwendbarkeit von silage für die milchvieh fütterung. Das Wirtschaftseiq. Futterq, pp: 106-113.

Lanza, A., 1982. Dried citrus pulp in animal feeding. In: International Symposium on Food Industries and the Environment, Budapest, Hungary, pp: 189-198.

Lattemae, P., C. Ohlsson and P. Lingvall, 1996. The effect of molasses and formic acid on quality of red-clover silage. Swedish J. Agric. Res., 26: 31-41.

Marten, G.C. and R.F. Barnes, 1980. Prediction of Energy Digestibility of Forages with *in vitro* Rumen Fermentation and Fungal Enzyme Systems. (in) Proc. Int. Workshop on Standardization of Analytical Methodology for Feed WJ Pigden CC Balch and M Graham, Editors. Int. Dev. Res. Center, Ottawa, Canada.

Martinea, A. and M. Medina, 1982. Contribución al estudio de subproductos de la industria conservera de Murcia en la alimentación animal. Arch. Zootech., 31: 150-169.

SAS., 1985. SAS user's guide: Statistic. Statistical analysis systems institute Inc., Cary, NC.

Scerra, V., P. Caparra, F. Foti, M. Lanza and A. Priolo, 2001. Citrus pulp and wheat straw silage as an ingredient in lamb diets: effects on growth and carcass and meat quality. Small Ruminant Res., 40: 51-56.

Steel, R.C.D. and J.H. Torrie, 1980. Principles and procedures of statistics. A biometrical appoach. Mc Graw- Hill Book Company. New York.

Tilley, J.M.A. and R.A. Terry, 1963. A two-stage technique for in vitro digestion of forage. J. Br. Grassl. Soc., 18: 104-111.

Weinberg, Z.G., G. Ashbell and B. Horev, 1989. The effect of sorbic acid on loss reduction in orange peel storage. J. Sci. Food Agric., 46, 3: 253-258.