Journal of Biological Sciences 3(11): 1010-1015, 2003
ISSN 1727-3048

A Research on the Ensiling Possibilities of Johnson Grass (*Sorghum halepense*) Forage with Broiler Litter

V. Ayhan, [1]H. Özkul, [1]H. Basmacıoğlu and [2]C. Balabanlı
Department of Animal Science, Agricultural Faculty,
Suleyman Demirel University, Isparta, Turkey
[1]Department of Animal Science, Agricultural Faculty, Ege University, Izmir, Turkey
[2]Department of Field Crops, Agricultural Faculty,
Suleyman Demirel University, Isparta, Turkey

Abstract: This study was carried out to determine the ensiling characteristics and feed value of Johnson grass (*Sorghum halepense*) forage ensiled without and with broiler litter. Johnson grass forage and broiler litter were ensiled in the proportions of 100:0, 90:10, 80:20, 70:30, 60:40 on dry matter basis respectively. Silages were prepared in five-litre plastic bags and in all silage neither undesirable smell nor mould growth was occurred on the top of any silage 60 days later. After ensiling, the content of dry matter, crude protein and lactic acid, Metabolisable Energy and Net Energy Lactation of silage has been increased parallel to the proportion of broiler litter. The results showed that adding 40% of broiler litter in the silage on dry matter basis was successfully ensiled with Johnson grass forage.

Key words: Johnson grass forage, broiler litter, ensiling characteristics, feed value

Introduction

Now-a-days, the economical feeding of ruminants mainly depends on the production of high quality, inexpensive and adequate of hay forage. Especially, the yield and quality of pasture and meadow in Turkey that provides the majority of hay forage has been tremendously reduced due to over grazing and mismanagement. Improvement of pasture and meadows, increasing of forage production area, in addition to the investigation of cheaper forage sources is necessary for animal feeding. As a matter of fact cotton stem silage (Alçiçek ***et al.***, 1995); aubergine stem and leaf silage vine bud and leaf silage (Alçiçek ***et al.***, 1999); pepper stem and leaf silage (Alçiçek ***et al.***, 1998) and artichoke stem and leaf silage (Alçiçek ***et al.***, 2000) were determined for alternative feeds. On the other hand, recently broiler litter has been used as an economical feed in ruminant diets. Broiler litter is consisted of the bedding material, excreta from the broilers, spilled feed, feathers and some foreign materials. The main nutritional constitutions of broiler litter for ruminant feeding are high level of protein (average 25% crude protein, 45% real protein, 55% NPN), mineral (25%, especially Ca and P), Metabolisable Energy (8.77-10.02 MJ kg^{-1}) and crude fibre (Rankins, 1995). Although the broiler litter contains high nutrient contents, it may be conclude with some problems because of pathogen micro-organism

(Salmonella, Coliform, Clostridium, Shigella, Proteus). Thus, the litter must be processed before it can be used as feed. Acceptable methods of processing litter to make ruminant feed include deep stocking, ensiling, dehydrating and extrusion-pelleting. Ensiling is the method that is one of the choice of for processing broiler litter mixed with different feeds. As a matter of fact a research on fermentation characteristics and feed value of broiler litter ensiled with corn forage (Chaudhry ***et al.***, 1995) proved that ensiled adding 40 % broiler litter to corn forage on wet basis, this mixture has very rich protein source and destroyed some pathogen, were occurred. In Turkey, 50% broiler litter and 50% corn forage mixture were successfully ensiled on dry matter basis and these results showed that broiler litter is a good source of protein, energy and mineral matter (Ayhan ***et al.***, 1999). According to these results broiler litter may be ensiled with corn forage which has low protein content. However, broiler litter can not only be mixed with corn forage but also can be mixed with barley, oat, Johnson grass, sorghum, Bermuda grass, carrot, potatoes pulp, apple pulp, citrus pulp, grape marc, sugarbeet pulp, tomato pulp, brewery pulp, olive cake etc. (Rude and Rankins, 1994).

This study was carried out to determine the ensiling characteristics and feed value of Johnson grass forage ensiled without and with broiler litter.

Materials and Methods

In this research, Johnson grass forage that was grown as weed in the Field Crops Department of Ege University Faculty of Agriculture and broiler litter that was collected from broiler production house of Animal Science Department of Ege University Faculty of Agriculture were used as feed material. Johnson grass forage and broiler litter were ensiled in the proportions of 100:0 (Group I), 90:10 (Group II), 80:20 (Group III), 70:30 (Group IV) and 60:40 (Group V) on dry matter basis respectively. Johnson grass forage was harvested at the seed maturing stage and brought to the laboratory. The grass was cut at a length of 5-6 cm using a mechanical forage cutter and manually mixed with broiler litter. Mixed materials were placed in five-litre plastic bags and each group were prepared with three replications. All of the bags were closed carefully. The bags were opened after a fermentation of 60 days and silages were analysed for physical and chemical properties. Crude nutrients, crude cellulose and silage acids (lactic acid, acetic acid and butyric acid) were determined by Weende Method (Naumann and Bassler, 1993); Lepper Method (Bulgurlu and Ergül, 1978) and Distilation Method (Naumann and Bassler, 1993); respectively. Determination of cell wall fraction were made by Van Soest Analysis Method (Goering and Van Soest, 1983). The pH values of silages were measured by electronical pH meter and the physical characteristics of silages were evaluated by silage evaluation scale (DLG, 1987). Metabolisable Energy and Net Energy Lactation content were calculated with regression equals using Acid Detergent Fibre parameter (SAS User Guide, 1989). Gross energy content was calculated by the values of the crude nutrients (DLG, 1991).

Results

Chemical composition of Broiler Litter (BL), Johnson grass forage and mixtures Johnson grass forage-broiler litter were presented on Table 1.

Table 1: Chemical composition of Broiler Litter (BL),Johnson grass forage and mixtures Johnson grass forage-broiler litter (n=3)

	Dry matter basis ,%						
	Wet basis (% of DM)	Organic matter	Crude protein	Ether extract	Crude cellulose	Nitrogen free extract	Crude ash
BL	90.77	89.82	25.91	4.29	14.27	45.35	10.18
Groups	Initial ensiling						
I	28.17	90.49	11.48	2.80	31.85	44.35	9.51
II	30.80	90.40	12.42	3.00	28.08	46.89	9.60
III	33.01	90.17	14.46	3.28	26.93	45.50	9.83
IV	35.06	90.01	15.18	3.59	25.70	45.64	9.99
V	38.24	90.31	15.38	3.53	26.77	44.64	9.69
	After ensiling						
I	24.87	89.87	11.15	3.73	32.30	42.69	10.13
II	28.51	89.73	13.58	3.92	29.58	42.65	10.27
III	30.61	89.33	14.97	4.02	28.41	41.93	10.67
IV	33.51	89.11	15.20	4.35	28.20	41.36	10.89
V	36.42	89.49	16.13	4.78	25.59	42.99	10.51

Table 2: Cell wall fractions of Johnson grass forage silage and ensiled mixtures Johnson grass forage-broiler litter, % of DM (n=3)

Groups	Neutral	Acid detergent fibre	Acid detergent fibre	Cellulose detergent lignin	Hemicellulose
I	66.52	46.60	7.22	35.18	23.17
II	64.52	43.34	9.42	30.04	24.57
III	60.27	39.56	7.38	29.22	23.35
IV	59.50	38.78	9.15	27.29	22.37
V	60.36	38.69	8.80	27.75	22.96

Table 3: Quality evaluation of Johnson grass forage silage and ensiled mixtures Johnson grass forage-broiler litter (n=3)

	Groups				
Silage quality specials	I	II	III	IV	V
pH value	5.32	5.10	4.94	5.00	5.05
Silage acids,%					
Lactic acid	0.71	1.13	1.04	1.69	2.14
Acetic acid	0.48	0.63	0.66	0.66	1.21
Butyric acid	0.00	0.00	0.00	0.00	0.00
Total acid	1.19	1.76	1.72	2.35	3.35
Total score	70	80	70	80	80
Quality classification	Good	Good	Good	Good	Good
Physicals characteristics					
Smell	8	8	4	4	4
Structure	4	4	4	4	4
Colour	2	2	2	2	2
Total score	14	14	10	10	10
Quality classification	Satis factory	Satis factory	Satis factory	Satis factory	Satis factory

Table 4: Average *in vitro* energy values of Johnson grass forage silage and ensiled mixtures Johnson grass forage-broiler litter (MJ kg^{-1} in DM) (n=3)

Groups	Gross energy	Metabolisable energy	Net energy lactation
I	18.07	7.71	4.34
II	18.15	8.20	4.68
III	18.16	8.77	5.08
IV	18.20	8.89	5.16
V	18.31	8.90	5.17

Before silage preparation dry matter (DM), crude protein , ether extract, crude cellulose, nitrogen free extract and crude ash in dry matter of Johnson grass forage were determined as 28.17, 11.48, 2.80, 31.85, 44.35 and 9.51%, respectively. As it can be seen on Table 1, the same values of broiler litter were 90.77, 25.91 5, 4.29, 14.27, 45.35 5 and 10.18%, respectively. Dry matter contents of silages changed between 30.80-38.24 % depending on the increasing levels of broiler litter. Crude protein content of silages were determined between 12.42-15.38%. Crude cellulose content were found between 28.08-26.77%. Organic matter quantity effected by crude ash content, increased from 9.51 to 9.99%. parallel to adding of broiler litter. Dry matter content after the ensiling was 24.87% and crude protein, crude cellulose and nitrogen free extract contents were found as 11.15, 32.30 and 42.69%, respectively. Dry matter contents of mixtures were determined between 28.51-36.42% and crude protein and ether extract contents in dry matter were increased between 13.58-16.13 and 3.92-4.78%, respectively. On the other hand, crude cellulose content of silage decreased from 29.58 to 25.59%.

Cell wall fractions of Johnson grass forage silage and ensiled mixtures Johnson grass forage-broiler litter were presented on Table 2.

Neutral Detergent Fibre, Acid Detergent Fibre and cellulose contents of mixtures were varied between 59.50-64.52, 38.69-43.34 and 27.29-30.04%, respectively. In this fractions while decreasing values were observed from Group I to Group V, the values belonging to Acid Detergent Lignin fractions were fluctuating between 7.38 and 9.42%.

Quality evaluation of Johnson grass forage silage and ensiled mixtures Johnson grass forage-broiler litter was presented on Table 3.

As seen on Table 3, from the point of the view of pH values the lowest and the highest values were determined in Group III with 4.94 and Group I with 5.32, respectively. Among the silage acids, lactic acid and acetic acid were increased in general as the rate of broiler litter increased in the mixtures. It was not found butyric acid in any silage. In quality classification, all of the silage groups were classified as good level.

On the other hand, the evaluation of physical properties of silage, the Group I and the Group II were scored 8 points and the other groups were scored 4 points. Adding broiler litter effected negatively only smell parameter of silage. However all of the silage groups were accepted in good satisfactory class in terms of physical characteristics.

Average ***in vitro*** energy values of Johnson grass forage silage and ensiled mixtures Johnson grass forage-broiler litter were presented on Table 4.

As it can be seen on Table 4, the nutrient contents of all silage groups are similar to each

other when evaluated according to Gross Energy. But, in general the Metabolisable Energy and Net Energy Lactation values of all the groups showed relatively increasing values compare to Group I. The highest Metabolisable Energy and Net Energy Lactation values were obtained from Group IV and Group V.

Discussion

Either initial or after ensiling, DM, crude protein, ether extract and crude ash content of silage has been increased with adding broiler litter to the Johnson grass forage at different levels. As a matter of fact some researchers have notified that nutrient amount was increased by adding of broiler litter. The source of increasing was resulted because of broiler litter increase in silage (Chaudhry ***et al.***, 1995; Ayhan ***et al.***, 1999). After ensiled, significant changes were observed in free extract values. Decreasing of crude cellulose in silage was occurred due to low crude cellulose content in broiler litter.

Neutral Detergent Fibre, Acid Detergent Fibre and Acid Detergent Lignin contents that are cell wall fractions of Group I were determined as 66.52, 46.60 and 7.22% respectively. The cell wall fractions of Johnson grass silage were higher than the broiler litter added other groups. This was occurred as a result of high crude cellulose content of Johnson grass compare to broiler litter. Increasing of mixed proportions in broiler litter added feeds while the cellulose and hemicellulose contents have been decreased, but Acid Detergent Lignin content has been increased. This situation can be explained due to less cellulose content and more lignin content in the broiler litter (Ruffin and Caskey, 1998, Ashbell ***et al.***, 1998). According to the pH values, physical characteristics, silage acids that depend on silage fermentation adding broiler litter in silage, look more suitable than single Johnson grass forage silage. In general, pH value were obtained as 5 and over in all groups (except Group III) . The pH values in a good quality silage must be between 3.90-4.60 or at least below 5.00 (Ashbell ***et al.***, 1998). In this research, the most suitable pH value was found in Group III. When the silage acid has been checked a significant increased can be seen from single Johnson grass forage (0.71%) to Group V (2.14%) at the broiler litter added silage. When the lactic acid level has increased, it is a positive indicator for silage quality. As a matter of fact, it is notified that lactic acid rate was increased by adding broiler litter (Chaudhry ***et al.***, 1995; Ayhan ***et al.***, 1999). Lactic acid level must be over 2%, acetic acid rate must be below 0.8% and no butyric acid should be present in a good quality of silage (Kılıç, 1986). In this research, acetic acid rates were found in Johnson grass silage as 0.48% in Group II, 0.63%, in Group III, 0.66% in Group IV and in 1.21% Group V. The Group V was found only above 0.8 %. This result was the reason for lowering the silage quality in the Group V even though the lactic acid rate was high. Butyric acid has never been found in all groups. Making an evaluation according to all silage acids, all of the groups have been in a good quality class with 70-80 points. On the other hand evaluation of physical characteristics, smell parameter values have decreased from Group III to Group V. But structure and colour parameters weren't showed differences significantly. As a matter of fact, it is notified that adding of high level broiler litter to Johnson grass forage caused to the variation on silage smell and colour (Ayhan ***et al.***, 1999). According to energy values that are calculated from ***in vitro*** data, Metabolisable Energy and Net

Energy Lactation contents showed increasing in large amount by adding broiler litter. This increasing was due to nutrient content of litter materials.

Keeping in view the results of the parent study support that the broiler litter is a good source of protein and can be ensiled successfully with Johnson grass forage. Adding 40% of broiler litter in the silage on dry matter basis was successfully ensiled with Johnson grass forage. So, environmental pollution of the broiler litter residues will be prevented. At the same time, Johnson grass that is called as weed will be an alternative feed source for ruminants.

References

Alçiçek, A., V. Ayhan and A. Kılıç, 1995. Pamuk sapının silolanma imkanı ve yem değeri üzerine bir araştırma. E.Ü.Z.F. Derg., 32: 103-110.

Alçiçek, A., E. Yaylak and H. Özkul, 1998. Alternatif kaba yem kaynakları üzerine araştırmalar I. Patlıcan sap ve yapraklarının silolanma imkanı ve yem değeri. Ege Bölgesi 1. Tarım Kong. Cilt, 2: 550-557.

Alçiçek, A., H. Özkul and E. Yaylak, 1999. Alternatif kaba yem kaynakları üzerine araştırmalar III. Asthma filizi ve yapraklarının silolanma imkanı ve yem değeri. E.Ü.Z.F. Derg, 36: 49-56.

Alçiçek, A., S. Tümer and H. Özkul, 2000. Kaba yem kaynağı olarak yapraklı enginar sapı silajının besin madde içeriği ve yem değeri üzerine bir ön çalışma. E.Ü.Z.F. Derg, 37: 27-34.

Alçiçek, A., H. Özkul and E. Yaylak, 1998. Alternatif kaba yem kaynakları üzerine araştırmalar II. Biber sap ve yapraklarının silolanma imkanı ve yem değeri. E.Ü.Z.F. Derg, 35: 89-96.

Ashbell, G., Z.G. Weinberg and Y. Hen, 1998. Recycling of broiler litter for cattle feed. 10 th European Poutry Congress. Jerusalem. Israel, pp: 21-26.

Ayhan, V., A. Alçiçek and M. Ergül, 1999. Einfluss von Broilereinstreu-Einsatz auf die Silagequalität den Futterwert von Grünmais. In 6. Symposium Deutsch-Türkische Agrarforschungen (In Kurzfassung), pp: 60-61.

Bulgurlu, Ş. and M. Ergül, 1978. Yemlerin fiziksel, kimyasal ve biyolojik analiz metodları. E.Ü.Z.F. Yayınları, No:127, Izmir.

Chaudhry, S.M., Z. Naseer and D.M. Chaudhry, 1995. Fermentation characteristics and nutritional value of broiler litter ensiled with corn forage. Poultry Abst., 21: 3273.

DLG, 1987. Bewertung von Grünfutter, Silage und Heu. DLG-Merkblatt, pp: 224.

DLG, 1991. DLG-Futterwerttabellen für Wiederkäuer. DLG-Verlag, Frankfurt.

Goering, H.K. and P.J. Van Soest, 1983. Forage fibre analyses. Agr. Handbook. N:379, Washington, USA.

Kılıç, A., 1986. Silo yemi. Bilgehan Basımevi. Bornova. Izmir, Turkey.

Naumann, C. and R. Bassler, 1993. Die chemische unterschung von Futtermitteln. Methodenbuch Band III, VDLUFA-Verlag, Darmstadt.

Rankins, Jr.D.L., 1995. Processing options for broiler litter. Feed Mix., pp: 3.

Rude, B.J. and Jr.D.L. Rankins, 1994. Evaluation of bermuda grass (***Cyndon dactylon***) and johnson grass (***Sorghum halepense***) an alternative to corn forage (***Zea mays***) for ensiling with poultry litter. Nutr. Abstrc. and Rev., 64: 75-81.

Ruffin, B.G. and T.A.Mc. Caskey, 1998. Feeding broiler litter to beef cattle. Alabama Cooperative Extension Service, Alabama: 5612, USA.