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The Usage Possibility of Apple Pomace Silage Prepared with Poultry Manure Addition in the Nutrition of Beef Cattle

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Abstract: This research was conducted to determine if there is a possibility of Poultry Manure (PM) ensiling with Apple Pomace (AP) and the possibility of the usage of produced silage as a nutritional stuff in the feeding of beef cattle. As a first step, PM, the weight of it was reference unit was blended with the AP at a ratio of 25 and 50%, ensilaged and the quality of the silage was examined. By the 60th day of the ensilaging process, pH values were 3.97 and 4.05 in the samples collected from 25 and 50% PM containing silage materials, respectively. The analyses of the same samples for the lactic, acetic and butyric acid ratios revealed as in 25% PM containing silage 1.727, 1.052 and 0.294% and in 50% containing silage 0.852, 0.693 and 0.877%, respectively. The second stage of the experiment was designed as 111 days of feeding trial and conducted with 8-10 months old Brown-Swiss male cattle with an average live weight of 333 kg and they were allocated into 3 groups, each of which composed of 8 animals. One of the groups was kept as a control. Silages containing 25 and 50% PM was provided as roughage to the remaining group, group I and II and they were used as trial groups. The control group was fed with a ration consisted of pelleted concentrate and wheat straw only. Lack of nutrients in the silages provided to the trial groups was completed with the similar concentrate and wheat straw given to the control group. At the end of the trial, the average live weight of the bulls in the control group, groups I and II were 452,456 and 461 kg and their daily weight gains were 1063,1108 and 1153 g, respectively. A statically significant difference with respect to daily weight gain was not observed among the groups. Throughout the experiment, the amount of dry matter for 1 kg weight gain in order of groups was 6.92, 6.74 and 6.27 kg and the cost of weight gain was 6578, 4775 and 4096 Turkish Liras, respectively. The examinations of rumen fluid for ammonium and urea nitrogen at the end of the feeding trial showed that the values were 10.6, 13.4 and 15.1 mg/100 mL and 12.3, 13.6 and 24.0 mg/100 mL in the groups, respectively and differences of these results were statistically significant ($p<0.01$). However, since the above values are below the toxic levels and toxic effects of these substances were not observed in the animals. Ammonia and urea nitrogen were also analyzed in the blood. At the end of the experiment while the blood ammonia values were 0.30, 0.34 and 0.52 mg/100 mL, respectively the respective urea nitrogen values were 5.75-9.30 mg/100 mL. The values for both parameters were higher in the animals of experimental groups compare to those of control group ($p<0.01$). Above results showed that preparation of silage by the addition of 25 and 50% PM to the AP is possible and the produced silages were consumed by the beef cattle without any negative effects on the weight gain and feed consumption and also provides an economic food supply.

Key words: Poultry manure, apple pomace, silage, beef cattle, food supply, nitrogen

INTRODUCTION

Despite the increasing population of the world, limited cultivable land shows the potential danger of big problems like famine for people and animals in the future. This situation indicates the necessity of saving for the future by using industrial by products as nutritional materials and creating new and economical nutritional sources. Especially insecticides like flies, bugs and microorganisms created by poultry businesses and fruit juice factories near the residential areas have come to a point that threatens the environmental health of those areas (Charles *et al*., 1992). It is asserted that a pH level of 4.0-4.2 and below should be achieved within the silage material to prevent the emergence of clostridium bacteria, help the anaerobic environment develop as needed and to provide the quality of the silage by having a sufficient level of easily digestible carbohydrates in the silage material (Allen and Stevenson, 1975; McDonald *et al*., 1973).

It is suggested that in quality silage pH should be between the values 3.8-4.2, lactic acid in the dry substance should be between 8-12%, one of the volatile fatty acids, acetic acid between 0.7-4% and butyric acid either 0.5% or none and that lactic acid occurrence in the silage environment helps support digestive processes, absorbance of calcium and provides the organism with the balance of acids and bases (McDonald *et al*., 1973). If the nutrition material to make silage is dirty or spoiled, it creates an increase in the levels of butyric acid which is

an undesirable organic acid in the development of silages and ammonia; additionally, an increase in the level of water in the silage decreases the consumption of dry substance and silage consumption is affected because of the difference of metabolites created by fermentation in different water levels (Van Soest, 1965).

It is found that poultry manure can be used as a feeding material for ruminants by ensilaging it with nutritional substance containing easily digestible carbohydrates like crops, root materials from plants, molasses, fruit juice and by-products from canned food industry and in ruminants fed with these silages, pathogenic microorganisms that can be harmful for animal health fall to a level where they cannot be effective or fall completely to zero (McClure and Fontenot, 1987; Ko *et al*., 1991; Hadjipanayiotou, 1984).

MATERIALS AND METHODS

Test animals: In the research, 24 male Brown-Swiss cattle present in the Pilot Feeding Unit of Veterinary Faculty of Uludag University, between the ages of 8 and 10 months were used. Animals were divided into three groups; one control and two trial groups with an average weight of 333 kg.

Rations used in the research: In the research, the control group was fed with wheat stalk as roughage and pelleted nurture food as concentrated food. The 1st trial group was fed with wheat stalk and according to their natural states, silage consisting of 25% poultry manure, 75% apple pomace as roughage and pelleted nurture food as concentrated food. The 2nd trial group was fed with wheat stalk and silage consisting of 50% poultry manure, 50% apple pomace as roughage. Additionally pelleted nurture food was given as concentrated food.

Determining the organic acids in the silage: The determining of the organic acids in the silage was made according to the Lepper method. The determination of raw protein, raw cellulose, raw fat, raw ash, calcium and phosphor from the silage materials and raw feeding materials was made in the Research and Application Laboratory of Veterinary Faculty Animal Feeding and Feeding Diseases Main branch.

Determining ammonia in the rumen fluid: It was done according to the method indicated in Merck Clinical Laboratory (Merck, 1974).

Determining urea in the rumen fluid: Determining urea in the rumen fluid was done by the support of the FrezerNeslerization method.

Determining the total volatile fatty acids in the rumen fluid: Determining the total volatile fatty acids in the rumen fluid was done in the Kjeldahlunit with the Steam Distillation method.

Determining ammonia in the blood serum: It was done according to the method indicated in Merck Clinical Laboratory (Merck, 1974).

Determining urea in the blood serum: Determining urea in the blood serum was achieved with the support of the Modified Gentzkw method.

Statistical analyses: Statistical computations for the groups and the importance of the differences among the average values of the groups was analyzed with the variance analysis method while the importance of the differences among the group was found according to the Duncan method.

RESULTS AND DISCUSSION

As known, one of the most important factors while determining the quality of the silage is the pH value of the silage material (Table 1). It is known by many researchers that when the silage is done with the suitable feeding materials and appropriately, it can be preserved without nutritional loss or rotting by the occurrence of the volatile fatty acids by the required amount and reducing the pH value down to 3.8 and 4.2 (Allen and Stevenson, 1975; McDonald *et al*., 1973).

The lactic, acetic and butyric acid levels in the sample of silage materials taken in the 60th day after the silage can be shown in Table 2. In quality silage, lactic acid in the dry substance should be between 8-12%, acetic acid between 0.7-4% and butyric acid at most

Table 1: The differences occurring in the pH values of the silage materials fed to the 1st and 2nd Trial groups through the process of silage

	pH				
Trial groups (Days)	3	15	30	45	60
1st trial group					
25% poultry manure+75% apple pomace silage	4.78	4.67	4.50	4.03	3.97
2nd trial group					
50% poultry manure+50% apple pomace silage	5.90	5.78	5.51	4.38	4.05

Table 2: The volatile fatty acid levels in the sample of silage materials taken in the 60th day after ensiling

	Organic acids (%)		
Trial groups	Lactic	Acetic	Butyric
1st trial group			
25% poultry manure+75% apple pomace silage	1.727	1.052	0.294
2nd trial group			
50% poultry manure+50% apple pomace silage	0.852	0.693	0.877

Table 3: Start of feeding to end of feeding animal weights and total daily increase of weight in the groups

Parameters	Control			Group I			Group II		
	n	$\bar{X}$	$S\bar{X}$	n	$\bar{X}$	$S\bar{X}$	n	$\bar{X}$	$S\bar{X}$
Start of feeding weigth (kg)	8	334	13.8	8	333	14.6	8	333	14.0
End of feeding weigth (kg)	8	452	15.3	8	456	16.5	8	461	12.8
Average daily rise of live weigth (g)	8	1063	53.7	8	1108	46.7	8	1153	62.6
Total rise of live weigth (kg)	8	118	5.9	8	123	5.1	8	128	6.9
Feeding length (Days)	111	-	-	111	-	-	111	-	-

Table 4: The changes occurring in the ammonia and urea nitrogen levels in the rumen of the groups during the feeding trial (mg/100 mL)

Time of sampling	Trial groups: The control group			I			II		
	n	$\bar{X}$	$S\bar{X}$	n	$\bar{X}$	$S\bar{X}$	n	$\bar{X}$	$S\bar{X}$
Start of the trial									
NH_3-N	8	10.7775^a	0.1456	8	12.0250^b	0.0785	8	13.3813^c	0.2275
Urea-N	8	12.7663^a	0.1705	8	13.4938^b	0.0798	8	16.4238^c	0.1490
30th day of the trial									
NH_3-N	8	10.7688^a	0.1012	8	12.3950^b	0.0956	8	13.8338^c	0.2293
Urea-N	8	12.9200^a	0.0520	8	16.1900^b	0.2643	8	18.9900^c	0.1543
60th day of the trial									
NH_3-N	8	10.6513^a	0.0881	8	12.9550^b	0.1125	8	14.3213^c	0.2170
Urea-N	8	12.9238^a	0.1188	8	17.8538^b	0.1322	8	23.2263^c	0.2242
End of the trial									
NH_3-N	8	10.6575^a	0.1157	8	13.4300^b	0.2079	8	15.1575^c	0.3229
Urea-N	8	12.3900^a	0.1190	8	18.6513^b	0.1877	8	24.0238^c	0.2351

Values that have the same letters in the same order were insignificant

0.5 (McDonald *et al*., 1973). In a study carried out by mixing corn meal with broiler manure, lactic acid, acetic acid and butyric acid levels were respectively 2.98, 0.68 and 0.03% in a silage containing 15% manure, 3.43, 0.72, 0.10% in a silage containing 30% manure, 3.66, 0.70 and 0.03% in a silage containing 45% manure in the 7th day of the silage (Ko *et al*., 1991).

When Table 3 is examined, the average daily gain of weight in the control group, the first and second trial groups were found to be 1063, 1108 and 1153 g, respectively. In the variance analysis, there were no significant differences among the groups ($p>0.05$).

The ammonia nitrogen in the rumen while it can show differences according to the ration can change in the range of 0-130 mg and the ammonia metabolism in the liver becomes insufficient when it exceeds 60 mmol L^{-1} (Church, 1979). As it can be understood from Table 4 although, there are statistically significant differences in all three of the groups' ammonia and urea nitrogen levels in the rumen according to the first and second trial groups containing different amounts of poultry manure, the values stayed within the normal rumen ammonia and urea nitrogen ($p<0.01$).

While the total volatile fatty acid levels in the rumen 0of the animals change according to the ration given to them, the value changes in the range of 80-150 mmol L^{-1} (Church, 1979). For the beef cattle fed in the field, no additional nurture was given to the first group, the second group was given molasses-urea mixture in addition to the field feeding and the third group was given grinded corn. In the rumen fluid taken in the 16th day after the start of the trial, the total amounts of the volatile fatty acids were 82.4, 84.3 and 75.8 mmol L^{-1}, respectively according to the groups (Rumsey *et al*., 1971).

As it can be shown in Table 5 in the analysis according to the total volatile fatty acid levels through the trials, the amounts of the total volatile fatty acids ranged between 86-96 mmol L^{-1} for the control group, 83-99 mmol L^{-1} for the first trial group and 89-105 mmol L^{-1} for the second trial group.

Although, there were no statistically significant differences in terms of the values taken through the feeding process between the control group and the first trial group, it was found that the second trial group had statistically significant differences in values when compared to the other two groups ($p>0.01$).

It was found for the ruminants fed with materials containing non-protein nitrogen that the concentration of ammonia rose but it did not exceed the toxic levels. While it changes with various factors, the amount of blood urea nitrogen in ruminants is indicated to be between 6 and 27 mg/100 mL.

As it can be shown in Table 6, the differences among the values of all the groups pooled at the end of the trial were found to be statistically significant ($p>0.01$).

Table 5: Total volatile fatty acid and pH values in the rumen fluid of different groups

	Trial groups								
	Control group			I			II		
Time of sampling	n	$\bar{X}$	$S\bar{X}$	n	$\bar{X}$	$S\bar{X}$	n	$\bar{X}$	$S\bar{X}$
Start of the trial									
pH	8	6.3375[a]	0.0419	8	6.4000[a]	0.0567	8	6.4250[a]	0.0619
T. VFA (Mmol L^{-1})	8	86.7000[a]	1.8439	8	83.4875[a]	1.7698	8	89.3000[b]	0.7626
30th day of the trial									
pH	8	6.3500[a]	0.0327	8	6.3375[a]	0.0460	8	6.4125[a]	0.0398
T. VFA (Mmol L^{-1})	8	90.6875[a]	1.1150	8	93.2000[a]	1.1445	8	96.5625[b]	1.1436
60th day of the trial									
pH	8	6.2625[a]	0.0375	8	6.3375[a]	0.0378	8	6.3375[a]	0.0378
T. VFA (Mmol L^{-1})	8	91.2625[a]	0.9062	8	94.7875[a]	0.9196	8	99.5625[b]	1.2466
End of the trial									
pH	8	6.3125[a]	0.0440	8	6.3250[a]	0.0411	8	6.3875[a]	0.0295
T. VFA (Mmol L^{-1})	8	95.7875[a]	1.5032	8	98.5250[a]	1.0320	8	104.5375[b]	1.4404

Values that have the same letters in the same order were insignificant

Table 6: The ammonia nitrogen and urea nitrogen values in the blood taken from the research animals at various time intervals (mg/100 mL)

	Trial groups								
	Control group			I			II		
Time of sampling	n	$\bar{X}$	$S\bar{X}$	n	$\bar{X}$	$S\bar{X}$	n	$\bar{X}$	$S\bar{X}$
Start of the trial									
NH_3-N	8	0.3063[a]	0.0150	8	0.3275[a]	0.0050	8	0.4425[b]	0.0150
Urea-N	8	5.7538[a]	0.1977	8	5.9000[a]	0.1511	8	6.0163[a]	0.1490
30th day of the trial									
NH_3-N	8	0.3113[a]	0.0158	8	0.3300[a]	0.0050	8	0.4813[b]	0.0127
Urea-N	8	5.8175[a]	0.1048	8	6.9263[b]	0.0482	8	7.7725[c]	0.1217
60th day of the trial									
NH_3-N	8	0.3063[a]	0.0154	8	0.3325[a]	0.0061	8	0.5125[b]	0.2170
Urea-N	8	5.8688[a]	0.0990	8	7.7500[b]	0.1369	8	8.9625[c]	0.1212
End of the trial									
NH_3-N	8	0.3000[a]	0.0111	8	0.3463[a]	0.0035	8	0.5275[c]	0.061
Urea-N	8	5.9963[a]	0.1032	8	8.8400[b]	0.1009	8	9.3012[c]	0.1940

CONCLUSION

This study shows that the increase in the live weight was greater for the first trial group than the control group and for the second trial group than the first trial group. As a result, it can be said that poultry manure can be ensilaged by mixing with apple pomace and these silages can be used as economical feeding materials in feeding beef cattle.

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