

**EFFECT OF BIOLOGICAL TREATMENTS OF GREEN
CORN STALKS AND SUGAR CANE TOPS ON
LAMBS GROWTH PERFORMANCE**

By

HANAN ABDALLAH AMIN MOHMMED SAAD

B. Sc. Agric. Sc. (Animal Production), Fac. of Agric., Ain Shams Univ., 2003

M. Sc. Agric. Sc. (Animal Nutrition), Fac. of Agric., Ain Shams Univ., 2010

**A Thesis Submitted in Partial Fulfillment
Of
the Requirements for the Degree of**

DOCTOR OF PHILOSOPHY

**in
Agricultural Sciences
(Animal Nutrition)**

**Department of Animal Production
Faculty of Agriculture
Ain Shams University**

2020

ABSTRACT

Hanan Abdallah Amin Mohmmed Saad. Effect of Biological Treatments of Green Corn Stalks And Sugar Cane Tops on Lambs Growth Performance. Unpublished Ph.D. Thesis, Department of Animal Production, Faculty of Agriculture, Ain Shams University, 2019.

green and dry Corn stalks and green and dry sugar cane tops were treated with *Lactobacillus plantarum* and/or ZAD to study its effects on chemical composition and cell wall constituents as well as to study the possibility of replacing part of green fodder with treated by products.

Biological treatments using ZAD + *Lactobacillus plantarum* and ZAD resulted in an increase in the content of green and dry corn stalks, green and dry sugar cane tops, protein and ash of the ether extract, but while decrease in organic matter, crude fiber and different fiber fraction and nitrogen free extract. Biological treatment of *Lactobacillus plantarum* did not affect the above-mentioned residues compared with control.

Biologically treated green and dry corn stalks were carried on farm and chosen due to its great effect on reducing NDF, ADF and CF and increasing CP compared with biologically treated dry and green sugar cane tops.

Twenty-four animals of Ossimi sheep were used with an average weight of about 25.5 ± 0.5 kg after weaning. The animals were randomly divided into six groups.

Each group containing four animals to receive one of three treatments as follow. C: (group1 and group2) animals were fed 33 % concentrate feed mixture + 67% (green and dry) corn stalks (untreated). Second treatment (ZP): (group3and group4) animal were fed 33% concentrate feed mixture + 67% (green and dry) corn stalks treated with (ZAD + *Lactobacillus plantarum*). Third treatment (ZAD): (group5 and group 6) animal were fed 33% concentrate feed mixture + 67 % (green and dry) corn stalks treated with (ZAD).

Results indicated that ZP and ZAD treatments with (green and dry) corn stalks decreased CF and NDF, ADF, ADL contents and increased CP content compared to the untreated by products.

Feeding lambs on treated corn stalks (green and dry) significantly ($P < 0.05$) improved all of nutrients digestibility compared with those fed on control. The nutritive values as TDN and DCP for lambs fed treated (green and dry) corn stalks showed significant ($P < 0.05$) higher values than those fed untreated and it had the same trend of nutrient digestibility. Adding *Lactobacillus palantarum* + ZAD improved digestion coefficients of nutrients and TDN values compared with control.

Treatment groups (green and dry) corn stalks showed significant increases ($P < 0.05$) in the pH values of the rumen fluid compared to the control treatment. The treatment groups (treatment 1, treatment 2) recorded the highest significant value ($P < 0.05$) for volatile fatty acids of rumen fluid compared to control (treatment 1). ZP and ZAD recorded the highest value ($P < 0.05$) for rumen ammonia concentration compared with control.

Results of blood parameter indicated that ZP and ZAD of (green and dry) corn stalks had a significant ($P < 0.05$) effect on (Tp, Alb, Glb, A/G) compared to the Control of (green and dry) corn stalks. All values of plasma ALT and AST for all treatments were in normal range where all treatments had no effect on ALT. However, (green and dry) corn stalks had a significant ($P < 0.05$) effect on AST compared to the control. All values of plasma creatinine and urea for biological treatments appeared to have significant ($P < 0.05$) higher values. However, these values were in normal range. Results indicated that biological treatment on (green and dry) corn stalks decreased plasma blood (glucose, triglycerides and cholesterol) compared with control

Biological treatment, ZP and ZAD with (green and dry) corn stalks, resulted in an increase in final body weight, daily gain and total increase during the growth period of the experiment (120 days) compared

to the untreated control group. Improvements were observed in the mean values of feed conversion as DM, DCP and TDN for the groups ZP and ZAD compared to the control groups.

Keywords: Corn stalk, corn stalks, *Lactobacillus plantarum* Silage, Biological Treatment, Cellulose enzymes, ZAD, digestibility, nutritive value, rumen liquor parameters, blood plasma parameters, ossimi sheep.

CONTENTS

	Page
LIST OF TABLES	VI
LIST OF FIGURES	VIII
LIST OF ABBREVIATIONS	X
1. INTRODUCTION	1
2. REVIEW OF LITERATURE	3
2.1. Wastes and by products as animal feeds.....	3
2.2. Nutritive value	3
2.2.1. Factors affecting the nutritive value of crop residues.....	4
2.2. 1.1. Environmental factors.....	4
2.2.1. 2. Animal factors.....	5
2.2.1.3. Plant factors.....	5
2.2.2. Corn stalk (dry corn) & corn Stover (green corn).....	6
2.2.3. Chemical composition.....	7
2.2.3.1. Part of the plant.....	7
2.2.3.2. Growing stage.....	7
2.2.4. Nutritive value.....	8
2.3. Methods to improve the feeding value of by products and crop residues.....	9
2.3.1. Physical methods.....	9
2.3.1.1. Chopping (grinding) and pelleting.....	10
2.3.1.2. Kneading (rubbing).....	10
2.3.1.3. Irradiation.....	10
2.3.1.4. High pressure steaming.....	10
2.3.2. Chemical methods.....	11
2.3.2.1. Alkali treatment.....	11
2.3.2.1.1. Sodium hydroxide treatment.....	11
2.3.2.1.2. Calcium oxide treatment.....	12
2.3.2.1.3. Acid treatments.....	12
2.3.2.1.4. Urea treatments.....	13

	Page
2.3.2.2. Mode of action of chemical treatments.....	14
2.3.3. Supplementation.....	14
2.3.4. Biological methods.....	15
2.3.4.1. Regular ensilaing.....	15
2.3.4.2. Fungi treatment.....	15
2.3.4.3. Fiber-degrading enzymes.....	17
2.3.4.4. Bacterial additives.....	19
2.3.4.5. . Lactobacillus plantarum.....	20
2.3.4.6. Mode of action of biological treatments.....	21
2.3.4.6.1 Mode of action of fungal enzymes.....	22
2.3.4.6.2. Mode of action of bacteria.....	24
2.3.4.6.3 Mode of action of enzymes.....	25
2.3.4.6.3.1 Lignin biodegradation.....	25
2.3.4.6.3.2. Cellulose biodegradation.....	26
2.3.4.6.3.3 Hemicellulose biodegradation.....	28
2.4. Scanning electron microscopy of by-products affected biological treatments.....	29
2.5. Scanning electron microscopy of by-products affected by chemical, biological and biochemical treatments.....	29
2.6. Effect of biological treatments on chemical composition and cell wall constituents.....	31
2.7. Effect of biological treatments on animal performance.....	34
2.7.1. Feed intake.....	34
2.7.2. Rumen kinetics.....	35
2.7.3. Digestibility.....	37
2.7.4. Blood chemistry.....	39
2.7.5. Daily gain.....	40
3. MATERIAL AND METHODS	42
3.1 The first experiment (Lab. Experiment).....	43
3.1.1. Biological compounds ZAD and Lactobacillus plantarum.....	43
3.1.2 Preparation of samples.....	43

	Page
3.1.3 Ensiling.....	44
3.1.4. Proximate chemical analysis.....	44
3.1.5. Cell wall constituents analysis.....	45
3.2. The Second Experiment (Metabolism trials).....	45
3.2.1 Ensiling	45
3.2.2. Metabolism trials.....	46
3.2.2.1. Chemical analysis	47
3.2.2.2 Sampling of rumen liquor.....	47
3.2.2.1 Rumen liquor analysis.....	47
3.2.2.1.1 Rumen pH value.....	47
3.2.2.1.2 Ammonia nitrogen (NH ₃ -N).....	47
3.2.2.1.3 Total volatile fatty acids (TVFA's).....	47
3.2.2.2. Sampling of blood.....	48
3.2.2.2.1 Total protein.....	48
3.2.2.2.2. Albumin.....	48
3.2.2.2.3 Globulin.....	48
3.2.2.2.4. Albumin: Globulin ratio (A/G ratio).....	48
3.2.2.2.5 Transaminases.....	49
3.2.2.2.6. Blood Urea.....	49
3.2.2.2.7. Creatinine.....	49
3.2.2.2.8. Glucose.....	49
3.2.2.2.9. Triglycerides.....	49
3.2.2.2.10. Cholesterol.....	49
3.3. The third experiment (Growth trial).....	49
3.3.1 Feed conversions ration calculation.....	50
3.3.4 Statistical analysis.....	50
4. RESULT AND DISCUSSION	51
4.1. The first Experiment (Laboratory trial).....	51
4.1.1. Chemical composition and cell wall constituents of green and dry corn stalks and green and dry sugar cane tops on dry matter basis.....	51

	Page
4.1.2. The chemical composition and cell wall constituents of green and dry corn stalks and green and dry sugar cane tops as affected by biological treatments. (Effect of roughage).....	55
4.1.3. Effect of biological treatment on proximate chemical composition and cell wall constituents of roughages (on DM basis).....	60
4.2. The Second Experiment (Metabolism trial).....	67
4.2.1.1. Nutrient digestibility and nutritive values of green and dry corn stalks which were affected by biological treatments.....	67
4.2.1.2. Effect of treatments on apparent nutrient digestibility and nutritive values of ration containing treated green and dry corn stalks.....	74
4.2.2. Effect of treated of green and dry corn stalks ration on some rumen liquor parameters.....	74
4.2.2.1. pH.....	74
4.2.2.2. Total volatile fatty acids (TVFA'S).....	76
4.2.2.3. Ammonia nitrogen.....	78
4.2.3. Some blood plasma parameters of green and dry corn stalks rations which were affected biological treatments.....	81
4.2.3.1.1. Total protein (TP).....	81
4.2.3.1.2. Albumin (ALB).....	81
4.2.3.1.3. Globulin (GLB).....	81
4.2.3.1.4. Values of Albumin: Globulin ratio (A/G ratio).....	81
4.2.3.1.5. Transaminases.....	83
4.2.3.1.6. Creatinine.....	83
4.2.3.1.7. Urea.....	83
4.2.3.1.8. Glucose.....	83
4.2.3.1.9. Triglycerides	84
4.2.3.1.10. Cholesterol.....	84
4.2.3.2. Effect of treatments on some blood plasma parameters of lambs.....	85

	Page
4.2.2.2.1. Total protein (TP).....	85
4.2.3.2.2. Albumin (ALB).....	87
4.2.3.2.3. Globulin (GLP).....	87
4.2.3.2.4. Values of Albumin: Globulin ratio (A/G ratio).....	88
4.2.3.2.5. Transaminases.....	88
4.2.3.2.6. Creatinine.....	89
4.2.3.2.7. Urea.....	89
4.2.3.2. 8.Glucose.....	90
4.2.3.2. 9.Triglycerides.....	90
4.2.3.2.10. Cholesterol.....	91
4.3 The third experiment (Growth Trial).....	93
4.3.1. The growth performance of lambs fed biologically treated green and dry corn stalks.....	93
4.3.2. Effect of biological treatments on green and dry corn stalks ration on growth performance of lambs.....	95
5. SUMMARY AND CONCLUSION	99
6. REFERENCES	105
ARABIC SUMMARY	

LIST OF TABLES

Table No.		Page
1.	Effect of some fungal additives to make silage.....	16
2.	Effect of some commercial enzymatic additives to make silage.....	17
3.	Effect of some bacterial additives to make silage.....	19
4.	Chemical composition of the concentrate feed mixture (CFM %)......	46
5.	Chemical composition and cell wall constituents of green and dry corn stalks and green and dry sugar cane tops on dry matter basis.....	53
6.	The chemical composition and cell wall constituents of green and dry corn stalks and green and dry sugar cane tops as affected by source of by product.....	56
7.	Response of tested by products by treatments.....	59
8.	Effect of biological treatment on proximate chemical composition and cell wall constituents of roughages (on DM basis).....	61
9.	Response of tested by treatments by products.	64
10	Over all mean values of the chemical composition and cell wall constituents of green and dry corn stalks and green and dry sugar cane tops which were affected by treatments.....	65
10a	Values of the chemical composition and cell wall constituents of green and dry corn stalks and green and dry sugar cane tops which were affected by treatments.....	66

11	Nutrient digestibility and nutritive values of green and dry corn stalks ration which were affected by biological treatments.....	68
12	Effect of treatments on apparent nutrient digestibility and nutritive values of ration containing treated green and dry corn stalks.....	70
13	Overall means values of digestibility and nutritive values of green and dry corn stalks ration which were affected by biological treatments.....	70
14	Effect of treatments on ruminal pH.....	73
15	Effect of treatments on ruminal TVFA's (m.eq/dl).....	75
16	Effect of treatments on ruminal ammonia-N (mg/dl)...	77
17	Some blood plasma parameters of lambs fed biologically treated green and dry corn stalks rations...	79
18	Effect of treatments on some blood plasma parameters of lambs.....	86
19	Overall means of some blood plasma parameters of lamps fed biologically treated green and dry corn stalks rations.....	92
20	The growth performance of lambs fed biologically treated green and dry corn stalks treated biologically...	94
21	Effect of biological treatments on green and dry corn stalks ration on growth performance of lambs.....	96
22	Overall mean values of The growth performance of lambs fed biologically treated green and dry corn stalks treated biologically.....	98

LIST OF FIGURES

Fig. No.		Page
1.	Chemical composition and cell wall constituents of green and dry corn stalks and green and dry sugar cane tops on dry matter basis.....	53
2.	Effect of treatment on proximate chemical composition and cell wall constituents of green and dry corn stalks and green and dry sugar cane tops.....	56
3.	Effect of biological treatment on proximate chemical composition and cell wall constituents of roughages (on DM basis).....	61
4.	Nutrient digestibility and nutritive values of green and dry corn stalks which were affected by biological treatments.....	68
5.	Effect of treatments on apparent nutrient digestibility and nutritive values of ration containing treated green and dry corn stalks.....	70
6.	Effect of treatments on ruminal pH.....	75
7.	Effect of treatments on ruminal TVFA's (m.eq/dl)...	77
8.	Effect of treatments on ruminal ammonia-N (mg/dl).....	80
9.	Some blood plasma parameters of lambs fed biologically treated green and dry corn stalks rations.....	82
10.	Some blood plasma parameters of lambs fed biologically treated green and dry corn stalks rations which were affected by biological treatments.....	84
11.	Effect of treatments on some blood plasma parameters of lambs.....	86
12.	Effect of treatments on some blood plasma	

Fig. No.		Page
	parameters of lambs.....	91
13.	The growth performance of lambs fed by green and dry corn stalks treated biologically.....	94
14.	Effect of biological treatments on green and dry corn stalks ration on growth performance of lambs.....	97