Assessment of the Greenery Residues Silage

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Presented by

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Why doing Silage?

- Animal feed cost constitutes up to 70% of the total cost of both livestock and poultry operations.
- Large quantities of greenery residues are available at present and will grow with the ever-increasing greenery plans in the country.
- The greenery residues can be either directly fed to animals as fresh fodder or in dried or fermented form known as silage.

Silage

- Ensilage can be a potential means for utilization of large amounts of greenery plant residues.
- A considerable interest has been developed in ensiling greenery residues as unconventional ingredients, along with chemical and microbiological processing to upgrade their nutritive value as animal feed.
- Storage of silage fodders are known to be safe and less expensive than storage of dried or fresh fodder

The Ensiling Process is Divided into Four Phases

- Phase1, the Aerobic phase;
- Phase 2, the Fermentation phase;
- Phase 3, is the Stable phase; and
- Phase 4 is the Feed-out phase or Aerobic Spoilage phase

Phase1

The atmospheric oxygen is reduced due to the respiration of the plant and aerobic microorganisms. Furthermore, plant enzymes, such as proteases and carbohydrates, are active provided that the pH is still within 6.5-6.0.

Phase 2

Starts when the silage becomes anaerobic within several days to several weeks. The lactic acid bacteria become the predominant population and, due to the production of lactic acid, the pH decreases to 3.8-5.0.

Phase 3

The stable phase as long as air is prevented from entering the silo.

Phase 4

This phase starts as soon as the silage is exposed to air. The onset of deterioration is due to the degradation of preserving organic acids by yeast's and acetic acid bacteria

Controlling and Optimizing Each phase

- Phase 1, good harvesting techniques and good silo-filling techniques will minimize the amount of oxygen and will, thus, minimize the water-soluble carbohydrate losses through aerobic respiration in the field and silo.
- Phase 2 and 3 are based on the use of silage additives applied at the time of ensiling.
- Phase 4 to minimize spoilage losses during storage, an airtight silo is required.

Objectives

- Evaluate the agriculture residues from 25 plant samples were selected, including ground covers, shrubs, trees, palms, lawn grasses and weeds to find their chemical, biochemical quality and microbial population.
- Prepare seven silage from the same selected plants and find out their chemical, biochemical quality and microbial population.

Material and Methods

- Plant Residues Collection and Preparation:
- Systematic and uniform collection of 25 species of plant residues was prepared. The list of greenery and landscape plant species planted are classified into five main categories; ground covers, shrubs, trees, palms and lawn grasses.

Plant Residues Groups

- They are five listed groups below

1- Ground covers, which included: *Carrisa grandiflora*, *Ipomoea biloba*, *Wedelia trilobata* and *Ipomoea batatus*

Ipomea biloba

Plant Residues Groups

2- Shrubs, which included:
Dodonaea viscose,
Thevetia peruviana,
Bougainvillea spp. and
Conocarpus lanceolatus

Conocarpus lanceolatus

Plant Residues Groups

- 3- Trees, which included: *Acacia Arabica*, *Acacia salicina*, *Albizia lebbek*, *Callistemon viminalis*, *Eucalyptus camaldulensis*, *Cordia mexa*, *Prosopis juliflora*, *Ficus infectoria*, *Parkinsonia aculeate*, *Prosopis chinensis*, *Pithecellobium dulcis*, *Zizyphus jujube*, *Olea europaea* , *Phoenix dactylifera*, and *Washingtonia robusta*

Acacia Arabica

Prosopis juliflora

Plant Residues Groups

- 4. Palms, which included: *Phoenix dactylifera* and *Washingtonia r*

Palm Tree

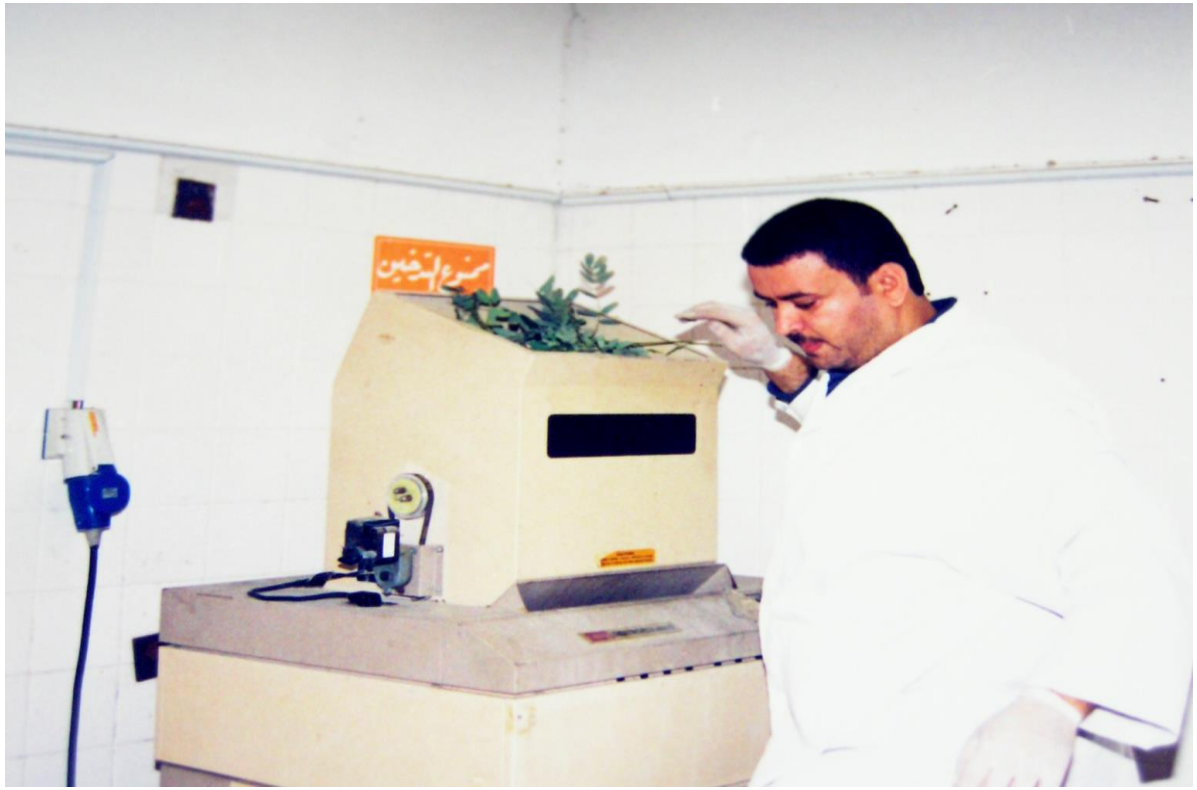
Plant Residues Groups

- 5. Lawn grasses, which included: *Paspalum vaginatum* and Weeds and mixed plant residues

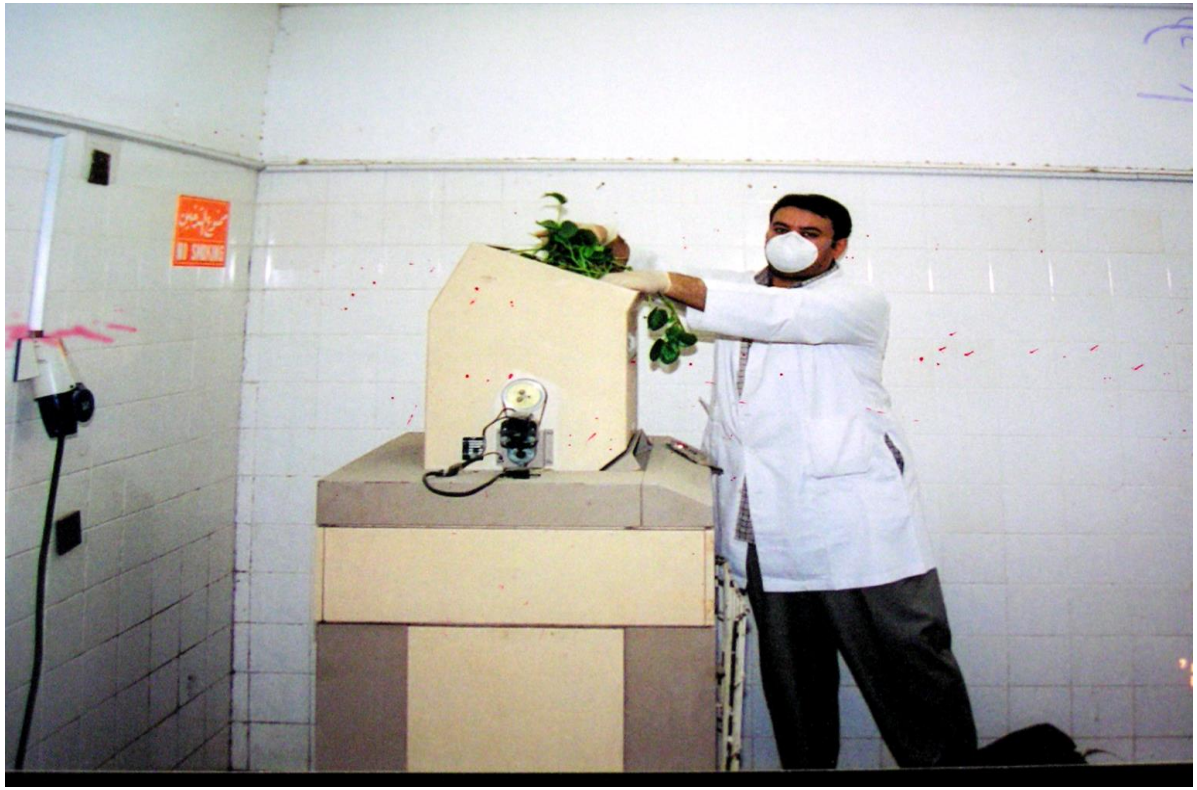
Plant Residues Preparation

- All fresh samples were shredded using a British-manufactured shredder into approximately 2-3 cm mesh size. For chemical and biochemical evaluation, samples should be dried at 70^{o} C then ground to be 2-3 mm particle sizes and stored into sealed plastic bottles for analysis.

Plant Residues Shredding using British Manufactured Shredder



Chipping of Plant residue



Silage's Preparation

- Seven different silage's types were made by weighing the shredded plant as a fixed ratio. Silage's should contain one of the five main categories; 30 % legume, 30 % lawn grasses, 10 % palms, 10 % ground covers, 10 % shrubs, 10 % trees (other than legumes).

Silage's Preparation

- In order to make 1 kilogram of plant mixture, Then 100 gm of ammonium sulfate and 300 gm of molasses were added and mixed with the addition of distilled water. The microbial suspension (*Lactobacillus plantarum* (NRRL-4496)) was added as 10 ml / 1 kilo silage. At the end, silage has were sealed and packed into plastic bags then incubated at 35oC for 20 days.

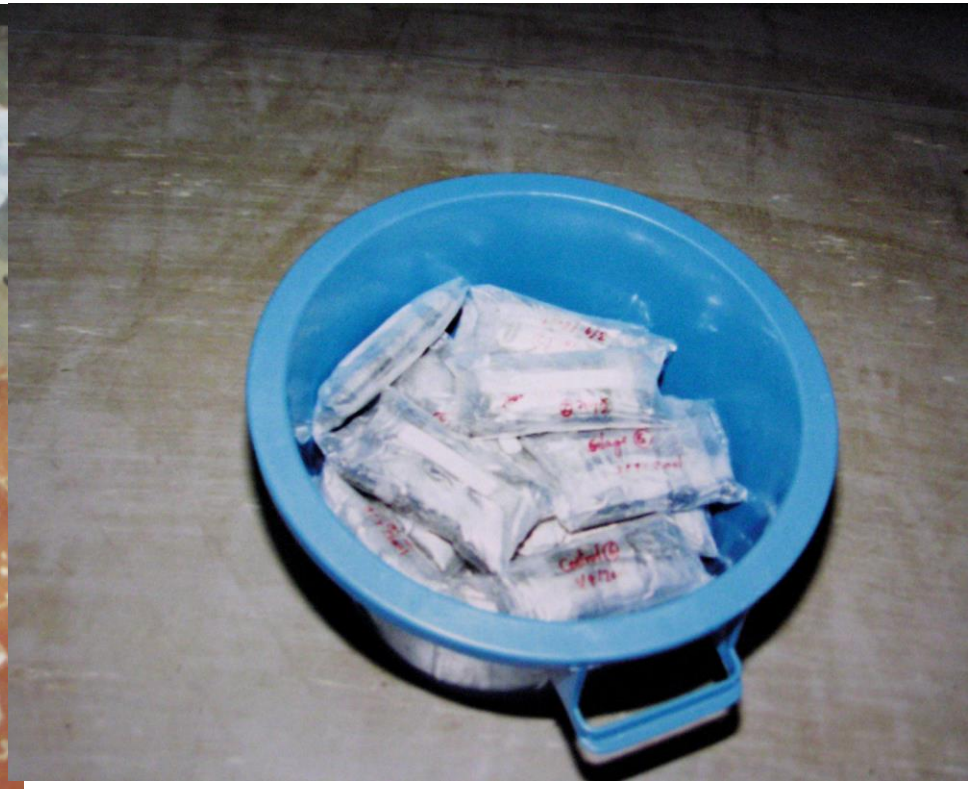
Check the Moisture of Plant Residues

Silage Preparation “addition of Microbial Inoculants’’

Silage Preparations “Molasses Addition”

Mixing of Silage Treatment before Sealing

Sealed Silage and Packed into Plastic Bags



Plant Residues and Silage's Evaluations

1. Chemical and Biochemical Analysis:

   moisture/dry matter (DM), ash, crude protein, crude fiber and crude fat, organic acids (Lactic, acetic, propionic and butyric) and water soluble carbohydrates.

2. Microbiological Analysis

3. Statistical Analysis

Result and Discussion

The 25 species of greenery plants were examined for their nutrient content. The assessment showed acceptable contents of crude protein (up to ≈ 25% on a dry matter basis), pH values, crude fiber and organic acids.

Chemical Composition Values (% on a dry matter basis)

- Moisture content ranged from 23.9 to 83.8%.
- Crude protein contents ranged from 4.6 to 21.9%.
- Crude fiber contents ranged from 13.6 to 39.1%.
- Crude fat contents ranged from 1.2 to 6.0%.

Silage's Analysis Results

- The physical texture and pleasant aroma indicated the successful anaerobic fermentation and the offensive smell of fermented molasses were suppressed in all the treated silages.
- The chemical evaluation as shown in Tables (1–5) present the chemical composition of the treated silages at 0 day, and 10 and 20 days of ensiling

Table 1. Contents of Moisture and Organic Matter of Treated Silages

Silage	Moisture (%)					Organic Matter (% on a dry matter basis)				
	0 d	10 d	20 d	Mean	SD	0 d	10 d	20 d	Mean	SD
Silage 1	57.99	58.61	57.33	57.98	0.64	86.25	85.88	86.02	86.05	0.19
Silage 2	61.13	62.31	61.61	61.68	0.59	83.18	82.04	81.77	82.33	0.75
Silage 3	56.08	58.10	57.54	57.24	1.04	84.30	83.52	83.28	83.70	0.53
Silage 4	57.11	58.70	57.16	57.66	0.90	84.91	84.69	84.71	84.77	0.12
Silage 5	59.81	60.67	60.39	60.29	0.44	85.64	85.20	84.90	85.25	0.37
Silage 6	59.61	59.23	59.20	59.35	0.23	85.14	84.94	85.20	85.09	0.14
Silage 7	58.86	59.96	59.86	59.56	0.61	84.53	84.38	83.81	84.24	0.38

Table2. Contents of Crude Protein and Crude Fiber (% on a dry matter basis)

Silage	Crude Protein					Crude Fiber				
	0 d	10 d	20 d	Mean	SD	0 d	10 d	20 d	Mean	SD
Silage 1	27.12	27.65	27.05	27.27	0.33	18.56	18.38	18.47	18.47	0.09
Silage 2	28.60	28.64	29.36	28.87	0.43	11.60	15.19	14.89	13.89	1.99
Silage 3	24.03	26.50	26.79	25.77	1.52	15.73	16.91	17.41	16.68	0.86
Silage 4	23.68	24.69	24.16	24.18	0.51	16.23	17.95	17.94	17.37	0.99
Silage 5	28.03	27.90	28.93	28.29	0.56	16.36	16.63	15.46	16.15	0.61
Silage 6	29.28	28.04	28.48	28.60	0.63	18.56	15.43	16.45	16.81	1.60
Silage 7	29.15	29.06	29.85	29.35	0.43	15.19	16.48	15.49	15.72	0.68

Table3. Contents of Crude Fat and Ash of Treated Silages (% on a dry matter basis)

Silage	Crude Fat					Ash				
	0 d	10 d	20 d	Mean	SD	0 d	10 d	20 d	Mean	SD
Silage 1	1.30	1.25	1.49	1.35	0.13	13.75	14.12	13.98	13.95	0.19
Silage 2	1.58	1.55	1.57	1.57	0.02	16.82	17.96	18.23	17.67	0.75
Silage 3	1.72	1.45	1.49	1.55	0.15	15.70	16.48	16.72	16.30	0.53
Silage 4	1.43	1.44	1.49	1.45	0.03	15.09	15.31	15.29	15.23	0.12
Silage 5	1.58	1.48	1.39	1.48	0.10	14.36	14.80	15.10	14.75	0.37
Silage 6	1.53	1.52	1.43	1.49	0.06	14.86	15.06	14.80	14.91	0.14
Silage 7	1.82	1.66	1.79	1.76	0.09	15.47	15.62	16.19	15.76	0.38

Table 4. Concentration of Organic Acids of the Treated Silages (% on a dry matter basis)

Silage	Acetic Acid					Propionic Acid				Butyric Acid
	0 d	10 d	20 d	Mean	SD	0 d	10 d	20 d	Mean	
Silage 1	1.04	1.7304	1.4581	ND	0.7514	0.2522	ND	0.3406	0.1277	
Silage 2	0.93	1.0829	0.9717	ND	0.1865	0.0103	ND	0.1469	ND	
Silage 3	1.15	1.0278	1.2378	ND	ND	0.1511	ND	ND	0.0872	
Silage 4	1.10	0.8575	1.2044	ND	0.0264	0.0133	ND	ND	ND	
Silage 5	1.20	0.6687	1.2485	ND	ND	0.1686	ND	ND	0.1316	
Silage 6	1.13	0.8056	1.0331	ND	ND	0.0410	ND	ND	0.0313	
Silage 7	2.85	1.3423	1.0185	ND	0.1088	0.0207	ND	0.0537	0.0139	

- ND = Not detected

Table 5. Concentration of Water-soluble Carbohydrates of the Treated Silages. (% on a dry matter basis)

Silage	0 d	After 10 d	After 20 d
Silage 1	3.8	1.8	1.7
Silage 2	3.6	2.2	1.6
Silage 3	4.6	2.1	1.8
Silage 4	3.1	1.8	1.8
Silage 5	5.6	2.4	1.9
Silage 6	5.3	1.8	1.6
Silage 7	3.6	1.7	1.9

Table 6. Logarithmic Enumeration of Microbial Populations of Treated Silages During Ensilage

Silage	Aerobic bacteria			Fungi			LAB		
	0 d	10 d	20 d	0 d	10d	20 d	0 d	10 d	20 d
Silage 1	7	5	4	6	5	3	6	5	3
Silage 2	8	8	4	7	7	4	7	7	4
Silage 3	6	7	6	6	7	5	6	7	6
Silage 4	6	5	4	5	5	4	5	6	3
Silage 5	8	7	5	7	6	5	7	6	6
Silage 6	8	8	5	7	7	8	7	7	8
Silage 7	8	6	8	7	6	8	7	6	8

Conclusion

- The greenery plantations of Kuwait's landscape are abundant and result in ever-increasing by-products.
- These agricultural residues could be utilized through bioconversion techniques as animal feeds.
- The chemical evaluations of these residues showed satisfactory nutritional values of chemical quantities.
- The investigations of this study stimulate to continue the ensiled greenery residues in pilot-scale for large scale production of silage.