Silage Quality of the Legumes *Vigna unguiculata* and *Canavalia brasiliensis* solely and with Sweet Potato Roots as an Alternative Pig Feeding

Siriwan Martens[1], Patricia Avila[1], Jorge L. Gil[2], Luis H. Franco[1], Michael Peters[1]

[1]Centro Internacional de Agricultura Tropical (CIAT), [2]Consorcio Latinoamericano y del Caribe de Apoyo a la Investigación y al Desarrollo de la Yuca (CLAYUCA), A.A. 6713, Cali, Colombia
s.martens@cgiar.org

S. Martens

1. INTRODUCTION

- As prices for feed concentrates are rising alternative options for small and medium pig producers in the tropics are sought.
- Locally grown legumes like *Vigna unguiculata* or *Canavalia brasiliensis* could contribute to the protein supply.
- Starchy roots and tubers such as sweet potato (*Ipomoea batatas*) (Fig. 1) could add to the energetic value.

Fig. 1: *Ipomoea batatas* var. Tainun

2. MATERIALS & METHODS

- *Vigna unguiculata* CIAT9611 and *Canavalia brasiliensis* CIAT17009 were evaluated at four different ages. *Vigna* was cut at 6 (pre-florescence), 8 (florescence), 10 (post-florescence) and 12 (pods ripening) weeks of growth;
- *Canavalia* was cut at 8, 12, 16 and 20 weeks of growth (no distinct generative stage observed).
- The forages were wilted to a target dry matter (DM) of 35% and then chopped (Fig. 2).

1. Cut & wilting **2. Chopping** **3. Compaction** **4. Storage**

Fig.2: Harvest and ensiling

- On each occasion sweet potato roots were harvested, washed, chopped and dried for several hours.
- The samples were ensiled in PVC tubes of 1.8 l Volume in triplicates.
- Three treatments were applied: *Vigna* or *Canavalia* only, *Vigna* or *Canavalia* mixed with sweet potatoes in the ratio 1:1 on fresh matter base, sweet potato only.
- The silages were evaluated after storage of approximately 3 months at 25 °C assessing their smell, structure and colour according to the DLG key for sensory evaluation (Fig. 3).
- DM, pH, ratio of ammonia-nitrogen (NH_3-N) to total N and volatile fatty acids were determined to be judged according to the DLG key for evaluation of silages based on chemical analysis.

3. RESULTS

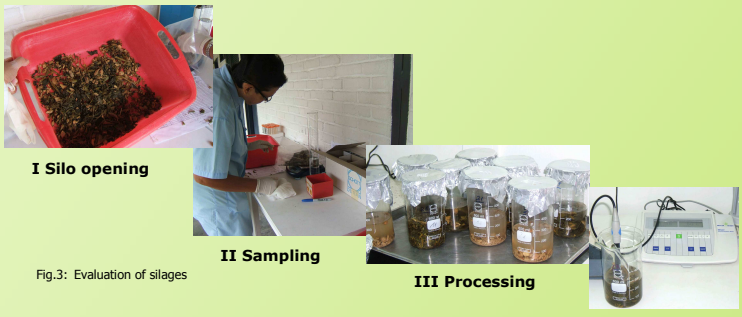
- *Canavalia brasiliensis* was difficult to chop and consequently to compact because of its long and fibrous twines.
- According to the organoleptic evaluation which emphasises the smell, silages ranged from very good to moderate/bad, and were good to satisfactory on average.
- Sweet potato only silage was rather subject to decomposing and decolouring than the forage legume silages.
- However, one of the *Vigna* (8 weeks) triplicates was completely rotten.

Tab.: Results of silage analysis

	% DM_{cor}	pH	Acetic acid	Propionic acid	Butyric acid[1]	% NH_3-N of total N	Organoleptic evaluation[2]
Vigna unguiculata							
6 weeks	33.9	5.5	0.6	0.1	0.2	14.5	1
8 weeks	19.7	6.0	1.4	0.3	0.7	25.5	3
10 weeks	35.0	5.2	0.9	0.2	0.1	8.4	2
12 weeks	31.1	4.6	0.5	0.1	1.4	5.3	3
Vigna/Ipomoea							
6 weeks	36.3	4.4	0.4	0.1	0.5	20.4	3
8 weeks	21.5	4.2	0.6	0.2	0.8	34.4	3
10 weeks	36.4	4.4	0.6	0.1	0.2	8.5	3[3]
12 weeks	56.9	4.6	0.4	0.1	0.1	7.6	1
Ipomoea batatas (* legume age)							
6 weeks*	28.6	3.8	0.6	0.2	0.1	-	4
8 weeks*	23.6	3.6	0.5	0.2	0.1	45.0	3
10 weeks*	38.5	4.4	0.7	0.1	0.0	8.5	1
12 weeks*	85.7[4]						
16 weeks*	35.4	4.2	0.4	0.1	0.0	16.0	3
20 weeks*	29.8	3.8	0.3	0.1	0.0	13.5	3
Canavalia brasiliensis							
8 weeks	42.2	5.3	0.7	0.3	0.0	15.2	3
12 weeks	35.9	5.1	1.2	0.3	0.0	10.5	3
16 weeks	27.3	5.3	0.9	0.2	0.1	12.4	1
20 weeks	31.2	5.2	1.3	0.1	1.6	12.4	2
Canavalia/Ipomoea							
8 weeks	33.1	4.3	0.6	0.3	0.0	13.8	3
12 weeks	55.5	4.8	0.5	0.2	0.0	8.6	2
16 weeks	33.7	4.5	0.5	0.1	0.0	16.0	2
20 weeks	33.3	4.3	0.8	0.1	0.6	11.0	3

Volatile fatty acids in % of DM; [1]iso-butyric acid analysis lacking; [2]mark 1 (very good)...5 (rotten); [3]however, mould growth inside made it unfeasible for feeding;[4] was too dry to ferment; - = missing value

- Chemical analyses revealed that silages of *Vigna* only prepared at a plant age of 6 and 8 weeks had a high degree of proteolysis, indicated by the percentage NH_3-N of total N (see table).
- A satisfactory acidification with legumes per se was only achieved with 12 weeks old *Vigna*, indicated by the pH in relation to the DM.
- The addition of sweet potato always improved the acidification.
- Sweet potato per se was easily fermentable.
- Acetic acid and propionic acid concentrations remained in an acceptable range.
- Final overall judgement is subject to the pending iso-butyric acid measurement, which was probably disturbed by 1,2-propanediol contents, produced by epiphytic heterofermentative lactic acid bacteria.



I Silo opening **II Sampling** **III Processing** **IV Analysis**

Fig.3: Evaluation of silages

4. SUMMARY & OUTLOOK

- The growth habit of *Canavalia brasiliensis* make it rather unsuited for processing to silage.
- The legume harvest age is important for the ensiling success, that is especially true for *Vigna unguiculata*, with best results at 12 weeks of growth (pod-ripening stage).
- The addition of sweet potato root generally improves the fermentation result. However, it can hardly diminish proteolysis.
- Next step to test the suitability as pig feeding will be the determination of the *in-vitro* digestibility.

This work was supported by