POTENTIAL OF *CITRUS SINENSIS* PEELS INCLUSION ON THE NUTRITIVE QUALITY OF *MEGATHYRSUS MAXIMUS* SILAGE

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Introduction

- Conservation of forage via silage making with local resources as additives has the potential to ameliorate the challenge of dry season provision of forages for ruminant farmers in countries where irrigation facilities are beyond the reach of farmers.
- About a million metric tonnes of orange peels produced annually in Nigeria are discarded as waste which can be processed as animal feed.
- Orange peels are rich in carbohydrates, cellulose, vitamins and bioactive components such as essential oil and lactic acid.
- Essential oil can reduce rumen methanogenesis in vitro (Bamikole et al., 2015) while the lactic acid content of the peel could enhance the acid content of the silage and its quality.
- *Megathyrsus maximus* is a common forage crop in Nigeria with a dry matter yield of 11.32 t ha^{-1} (Bamikole et al., 2004).
- Its excess growth in the rainy season can be conserved as silage for dry season feeding of ruminants.

Materials and Methods

- *M. maximus* was collected from natural grasslands while the orange peels were gathered from retailers who sell peeled oranges.
- The grass was chopped into 2 – 3 cm pieces to facilitate uniform mix with the peels and for proper silage consolidation.
- The peels were introduced at 0, 10 and 20% in the orange peel – grass mixture to form the experimental treatments which were ensiled in polythene bags.
- The silages were sampled at 2, 4, 6 and 8 weeks after ensiling.
- A 3 x 4 factorial arrangement was used to monitor the effect of the three inclusion levels and the four sampling times on the nutritive quality of the silage.
- Silage samples from the treatments were processed for chemical analysis and *in vitro* fermentation study using standard procedures.
- Rumen liquor from six goats fed on Guinea grass and concentrate supplement was filtered and mixed with buffer in ratio 2:1 and used in the silage incubation for 24h.
- Post incubation determination of Metabolizable energy (ME), organic matter digestibility (OMD%) and short chain fatty acid (SCFA) was achieved with previously established equations (Menke and Steingass, 1988; Getachew et al., 1999).
- Data were analyzed, using proc GLM procedure of SAS in a Completely Randomized Design.

Results

- The inclusion of *C Sinensis* peels had no effect on the dry matter (DM) content of the silage but the crude protein (CP) was significantly enhanced at 20% peel inclusion level.
- The DM and CP reduced significantly with sampling time except for DM of 20% *C. sinensis* peel silage.
- CP content reduction over time was more (33%) in sole grass silage and less (15%) in 20% peel silage.
- The neutral detergent fibre (NDF) and organic matter (OM) contents of the silage were not significantly affected with the peel inclusion.
- The NDF however increased significantly with the sampling time in the grass plus peels treatments only.
- The pH which was stable all through the sampling period was acidic for all the silages and reduced significantly with the addition of more peels to the silage.
- For in vitro fermentation parameters , the volume of CH_4 produced and SCFA was the same for all the silages
- The SCFA was also stable up to the 6th week of sampling but reduced significantly by 30% at week 8 for sole grass silage.
- The ME values of the silage were good, without significant treatment effect.
- Digestibility of DM and OM of the silages exceeded 50% in 24 hours without effect of peel inclusion .
- DM digestibility was sustained in all the sampling period for the mixed silages but reduced significantly after the 6th week in the silage of only grass.

Table 1: Chemical composition (%) of *M. maximus* + *C. sinensis* peels silage at different sampling times

VARIABLE	WEEK	TREATMENT 0% *C. sinensis*	10% *C. sinensis*	20% *C. sinensis*	SEM
DM	2	25.43$_{A}^{a}$	24.75$_{A}^{a}$	26.60$_{A}^{a}$	0.60
	4	22.13$_{B}^{ab}$	21.60$_{B}^{b}$	23.80$_{A}^{a}$	0.40
	6	22.45$_{B}^{a}$	22.14$_{B}^{a}$	23.20$_{A}^{a}$	0.65
	8	21.96$_{B}^{a}$	22.48$_{B}^{a}$	23.20$_{A}^{a}$	0.74
	SEM	0.15	0.39	0.41	
CP	2	6.13$_{A}^{b}$	6.83$_{A}^{a}$	7.00$_{A}^{a}$	0.143
	4	5.78$_{A}^{b}$	5.86$_{A}^{b}$	7.61$_{A}^{a}$	0.46
	6	5.25$_{A}^{b}$	5.43$_{AB}^{b}$	6.80$_{AB}^{a}$	0.54
	8	4.11$_{B}^{b}$	4.20$_{B}^{b}$	5.94$_{B}^{a}$	0.68
	SEM	0.69	0.41	0.40	
NDF	2	54.00$_{A}^{a}$	53.50$_{B}^{a}$	52.50$_{B}^{a}$	2.68
	4	58.50$_{A}^{a}$	65.50$_{A}^{a}$	61.50$_{AB}^{a}$	3.59
	6	58.50$_{A}^{a}$	60.50$_{AB}^{a}$	56.00$_{AB}^{a}$	4.92
	8	66.50$_{A}^{a}$	64.50$_{A}^{a}$	65.50$_{A}^{a}$	0.96
	SEM	4.93	1.94	2.38	
OM	2	88.75$_{A}^{b}$	89.50$_{A}^{a}$	89.50$_{A}^{b}$	0.14
	4	86.75$_{A}^{a}$	88.75$_{A}^{a}$	92.25$_{A}^{a}$	2.39
	6	88.00$_{A}^{a}$	88.75$_{A}^{a}$	89.00$_{A}^{a}$	0.72
	8	83.00$_{A}^{a}$	90.50$_{A}^{a}$	90.50$_{A}^{a}$	1.80
	SEM	1.74	0.64	1.94	
pH	2	6.40$_{A}^{a}$	5.30$_{A}^{b}$	4.68$_{A}^{c}$	0.12
	4	6.52$_{A}^{a}$	5.32$_{A}^{ab}$	4.74$_{A}^{b}$	0.18
	6	6.63$_{A}^{a}$	5.35$_{A}^{b}$	4.80$_{A}^{c}$	0.19
	8	6.55$_{A}^{a}$	5.45$_{A}^{b}$	4.98$_{A}^{c}$	0.15
	SEM	0.86	0.035	0.27	

SEM= Standard Error of Mean, ABC= means followed by the same letter(s) in the column, and abc = means followed by the same letter(s) in the row are not significantly different (P>0.05)

Table 2: Post in vitro parameters of *M. maximus* + *C. sinensis* peels silage at different sampling times

VARIABLE	WEEK	TREATMENT 0% *C. sinensis*	10% *C. sinensis*	20% *C. sinensis*	SEM
CH4	2	6.00$_{A}^{a}$	5.25$_{A}^{a}$	5.75$_{A}^{a}$	1.31
	4	5.50$_{A}^{a}$	5.00$_{A}^{a}$	5.25$_{A}^{a}$	0.76
	6	5.25$_{A}^{a}$	5.50$_{A}^{a}$	5.60$_{A}^{a}$	1.37
	8	5.00$_{A}^{a}$	4.88$_{A}^{a}$	5.14$_{A}^{a}$	0.76
	SEM	0.72	0.98	1.49	
SCFA	2	0.40$_{A}^{a}$	0.42$_{AB}^{a}$	0.48$_{A}^{a}$	0.04
	4	0.32$_{A}^{a}$	0.42$_{AB}^{a}$	0.36$_{A}^{a}$	0.03
	6	0.32$_{A}^{a}$	0.48$_{A}^{a}$	0.58$_{A}^{a}$	0.05
	8	0.28$_{B}^{b}$	0.28$_{B}^{b}$	0.46$_{A}^{a}$	0.02
	SEM	0.03	0.03	0.05	
ME	2	6.01$_{A}^{a}$	6.15$_{A}^{a}$	6.29$_{A}^{a}$	0.21
	4	5.75$_{A}^{a}$	6.10$_{A}^{a}$	5.84$_{A}^{a}$	0.19
	6	5.75$_{A}^{a}$	6.29$_{A}^{a}$	6.25$_{A}^{a}$	0.27
	8	5.58$_{A}^{b}$	5.56$_{B}^{b}$	6.07$_{A}^{a}$	0.02
	SEM	0.16	0.18	0.28	
OMD	2	54.33$_{A}^{a}$	54.84$_{A}^{a}$	55.95$_{AB}^{a}$	1.35
	4	53.93$_{A}^{a}$	54.89$_{A}^{a}$	50.95$_{B}^{a}$	1.39
	6	53.04$_{A}^{b}$	56.14$_{A}^{ab}$	58.72$_{A}^{a}$	1.62
	8	33.53$_{B}^{a}$	29.97$_{B}^{b}$	33.56$_{B}^{a}$	1.07
	SEM	1.14	1.22	1.72	
DMD	2	66.67$_{A}^{a}$	62.41$_{A}^{a}$	68.74$_{A}^{a}$	4.23
	4	57.94$_{AB}^{a}$	58.27$_{A}^{a}$	56.89$_{A}^{a}$	3.49
	6	60.64$_{AB}^{b}$	63.09$_{A}^{a}$	67.89$_{A}^{a}$	4.01
	8	52.83$_{B}^{b}$	53.72$_{A}^{b}$	66.31$_{A}^{a}$	3.99
	SEM	3.72	3.58	4.32	

SEM= Standard Error of Mean, ABC= means followed by the same letter(s) in the column, and abc = means followed by the same letter(s) in the row are not significantly different (P>0.05)

Conclusion

- *Citrus sinensis* peel inclusion at 20% in *Megathyrsus maximus* silage making can improve and sustain the crude protein and pH of the silage.
- It can also sustain short chain fatty acid production and dry matter digestibility during the feed out of the silage.

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